MISSILE AND AIRCRAFT PRODUCTION NUMBER

**JUNE 1960** 

# Machinery

Jacobs

New Model 50

The world's most modern collet chuck for lathes by ATLAS • DELTA • LOGAN SHELDON • SOUTH BEND

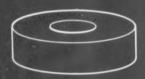
N - SOUTH BEND



SEE PAGES 48-49

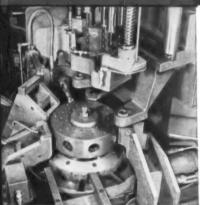
# 170 OPERATIONS 73 HOLES starting from solid

- DRILL
- REAM
- BORE
  - · COUNTER-BORE
    - · GROOVE
    - TAP









Above — Work stations on first machine (shown in large photo)

Below - Work stations on second machine



### Two 6-station Model S Bore-Matics

## **UP PRODUCTION 519%**

This cast-iron hydraulic motor body used to be produced on three different machines, with a total production time of 286 minutes per part. Now it is done on two 6-station Model S Bore-Matics in 46 minutes!

Each machine is equipped with Heald Red Head Borizers to rotate and feed the tooling, and a rotary indexing workholding fixture. Once the part is loaded, all operations are performed in sequence in a fully automatic cycle. After operations on the first machine are completed, the work is turned over and put on the second machine where the remaining operations are finished from the opposite face.

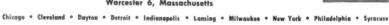
This job demonstrates the unusual versatility of Heald Borizer units—and their ability to handle heavy stock removal while maintaining required accuracy for each of numerous sequential operations. For complete details on this particular application, send for a copy of the April 1960 issue of the "Heald Herald."



It PAYS to come to Heald

### THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts



### **JUNE 1960** VOL. 66 No. 10

Editors

CHARLES O. HERB

Associate Editors:

FREEMAN C. DUSTON EDGAR ALTHOLZ RAYMOND H. SPIOTTA HAROLD W. BREDIN LAURENCE W. COLLINS, Jr.

Materials Editor: PAUL B. SCHUBERT **Shop Mathematics Editor:** 

HENRY H. RYFFEL

Published monthly by THE INDUSTRIAL PRESS. ROBERT B. LUCHARS, President; EDGAR A. BECKER, Vice-President and Treasurer; HAR-OLD L. GRAY, Secretary and Publishing Manager. Editorial, Advertising and Circulation Offices: 93 Worth St., New York 13, N. Y. Telephone, CAnal 6-8120.

### **Advertising Representatives**

WALTER E. ROBINSON GORDON BRAUNINGER

93 Worth St., New York 13, N. Y.

ROBERT J. LICK

313 E. 216th St., Cleveland 23, Ohio

EMMET J. O'CONNELL

228 N. LaSalle St., Chicago 1, III.

NORMAN O. WYNKOOP, Jr.

44 Highland Ave., Detroit 3, Mich.

DON HARWAY & CO.

1709 W. Eighth St., Los Angeles 17, Calif. RICHARD E. HOIERMAN

9006 Capri Drive, Dallas 18, Tex.

1201 Forest View Lane, Birmingham 9, Ala.

Subscription rates: United States and Canada, one year, \$10; foreign countries, one year, \$15; two years, \$28. Single copies, \$1.00; foreign, \$1.50. Changes in address must be received by the tenth of the month to be effective for the next issue. Send old as well as new address. Copyright 1960 by THE INDUSTRIAL PRESS.

Accepted as controlled circulation publication at Bristol, Conn.

Great Britain MACHINERY National House, West St., Brighton 1, England

> France LA MACHINE MODERNE 15, Rue Bleue, Paris-IX®, France





# Machinery

### THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

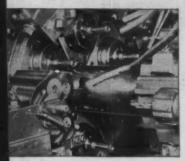
### SHOP PRACTICE

Eyes for the Hawk	Raymond H. Spiotta 12	22
Brazing Steel Honeycomb by Radiant	Heating Charles O. Herb 13	32
North American Ready to Build B-70	Prototypes Charles O. Herb 13	38
WALDO Spreads Its Wings	Raymond H. Spiotta 14	44
Induction Brazing Slashes Manifold-M	aking Time Edgar Altholz 10	60
Unconventional Tooling for Mach 2 H	ustler E. W. Feddersen 10	66
Big Stainless-Steel Slabs Machined fo	r Flexing in Super Wind Tunnel Milton Karr 17	78
Cut and Ground Thread Taps—13 an	d 14 (Data Sheet) 25	21
MACHINE AND TOOL DESIGN		
Precision Forgings and Extrusions by	the Dynapak Process F. A. Monahan 1.	54
Superstrength Rocket Chambers Made	from Paper-Thin Steel Charles O. Herb 1	74
Researching the "Refractories"	. Joseph H. Mainhardt and Donald Weisinger	84
Milling and Profiling Operations Med Transfer Machine		94
MANAGEMENT PROBLEMS AN	D MEETINGS	
What the Space Age Has Done to Us	Charles O. Herb 1	19
Exposition and Standardization—The	mes of Machine Tool Builders 1	89
Norton Opens New Grinding-Wheel I	Plant 1	90
Pratt & Whitney—100 Years of Acc	ruracy 1	92
DEP	ARTMENTS	
Keeping Up with Washington 1	17 Between Grinds	242
Latest Developments in Shop Equipment 1	96 News of the Industry 3	102
Data Sheet 2	21 Coming Events	318
New Catalogues 2	33 Book Reviews	222

### ADVERTISERS' INDEX 331



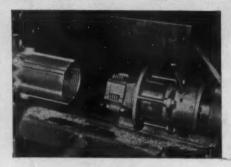
# How Landis guarantees



Rolling over 30 million threads



Cutting to .001 concentricity



Tapping coarse threads in less than a minute in one pass

# "threading results desired"



Grinding threads 71/4" per minute

The service after purchase each Landis customer receives is his guarantee that Landis equipment will produce threads that meet the degree of accuracy and production for which it was sold.

How does this guarantee work? Since our customers are also our best prospects we provide a multitude of services designed to meet their needs for attention, help and continued satisfactory operation of their Landis purchases.

SALES AND SERVICE REPRESENTATIVES . . . nationwide network . . . factory trained to apply Landis equipment to the most efficient method of operation and keep it performing as such . . . accurate home-office records of customer equipment and operation assures efficient service.

COMPLETE LINE . . . of threading equipment enabling use of machine or tool best suited for the operation whether it be Cutting, Rolling, Tapping, Grinding . . . adequate inventory assures fast delivery.

LITERATURE . . . regular contact by mail keeps customer well informed . . . catalogs and operational handbooks received at time of purchase . . . demonstration movies available.

ENGINEERING ASSISTANCE . . , leading engineers in the field offer help in analyzing and solving threading problems.

NEW PRODUCTS . . . research and development bring even better ways to further meet threading requirements.

QUALITY MANUFACTURE . . . rigid control and fine craftsmanship guarantees threading equipment that will perform with top efficiency, give maximum life, produce accurate threads.

Satisfied customers are our best recommendation. Investigate today the advantages Landis threading equipment has to offer for your plant.

# IS *Machine* COMPA

WAYNESBORO . PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT



















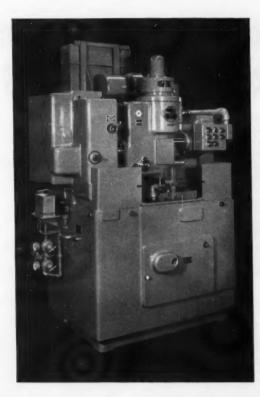
**INVOLUTE GEARS** 



**FELLOWS** 

**NON-INVOLUTE PARTS** 





Fellows 4GS Gear Shaper

# **GEAR SHAPERS DO DOUBLE DUTY**

Fellows Gear Shapers are not limited to the production of gears alone. They are valuable production machines ideal for the manufacture of many types of parts, of both involute and non-involute form.

As gear shapers, they provide high production rates in the manufacture of internal and external spur and helical gears. As general purpose production machines, they also make possible the economical production of irregularly shaped parts . . . in many cases doing in one simple operation what would require several operations using conventional shop tools.

If you manufacture gears in your plant, chances are the Fellows Gear Shaper is already an important part of your production process. If you manufacture irregularly shaped parts, find out how the Fellows Gear Shaper can help you increase production and cut costs.

Your Fellows representative will be happy to give you further information on the complete line of Fellows production and inspection equipment. Ask him, or write direct.

> THE FELLOWS GEAR SHAPER COMPANY 78 River Street, Springfield, Vermont, U.S.A. Branch Offices:

1048 North Woodward Ave., Royal Oak, Mich. 150 West Pleasant Ave., Maywood, N.J. 5835 West North Avenue, Chicago 39 6214 West Manchester Ave., Los Angeles 45

THE PRECISION Ellows Gear Production Equipment

# NEW 36-Station Transfer Line incorporates

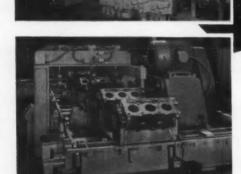
# WORLD'S LARGEST

... another

CINCINATI

BROACHING STATION. As blocks move through the line, the top, bank faces, pan rail, bearing pads, bearing locks and half bore are broached.

MILLING STATION. Pads are milled on the side of the block, and the front and rear ends are rough and finish milled. Front of block is being milled in this pholograph.



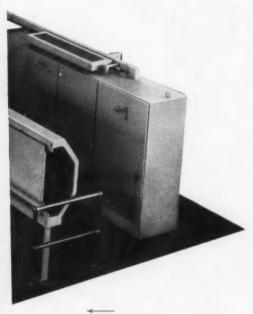
DESIGNERS AND BUILDERS OF SPECIAL MACHINES . VERTICAL AND HORIZONTAL BROACHING

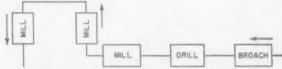
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

# BROACHING MACHINE

example of Dependable Productivity from

# CINCINNATI SPECIAL MACHINE





CINCINNATI 36-STATION TRANSFER LINE broaches, mills, drills and reams V-type engine blocks . . . all in one continuous opera-tion. Production—67 per 60 minute/hour.

In this special 36-station transfer line, the world's largest horizontal broaching machine is integrated with drilling and milling stations . . . for continuous, automatic machining of V-type automotive engine blocks. Cincinnati's Special Machine Division designed, built and assumed full responsibility for every detail of the line.

Twelve surfaces are machined on the broach, which has a 600 hp drive capable of developing a broaching force of 100 tons! Manufacturing holes then are drilled and reamed, and 10 surfaces milled, all in one continuous automatic operation. The line measures approximately 140 feet, and uses 30 motors capable of producing more than 1000 hp. Its design is such that three different bore sizes may be accommodated with very little change-over.

From the first broaching operation to the final interlock station, this giant production line is evidence of the capabilities of the Special Machine Division. In addition to over 45 years' experience in designing and building special machinery, Cincinnati offers the most extensive research and development, foundry and shop facilities in the machine tool industry. And you will be pleased with Cincinnati's follow-up service to assure dependability of performance. Our Field Engineers will be glad to give you an analysis of what the Special Machine Division can do for you.



COMPLETELY AUTOMATED PRODUCTION LINES

# Landis grinder with new Size Finder

new Landis development with Microfeed lowers grinding costs on lathe headstock spindle...saves setup time...assures close tolerances





LANDIS TOOL COMPANY

# saves 82 minutes grinding 9 diameters

### production data

Part: . . . . . Lathe headstock spindle

Machine: . . . . Landis 10" x 48"

Plain Grinder with Size Finder
and Microfeed

Operation: . . . . Grinding 9 different diameters.
One diameter is tapered

Production:.....With new Landis Size Finder—
1 part every 42 minutes

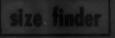
Former method—1 part completed in 124 minutes

Stock removal: ...020"-.030"

Part tolerances: Size—.0005" max. Roundness—.00005" max. Straightness—.0001"

Finish: . . . . . . . 25 RMS





# How size finder speeds multiple diameter shaft grinding

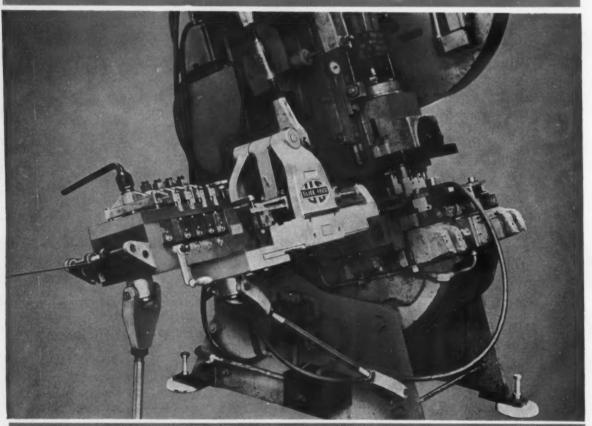
The new Landis Size Finder is a direct reading indicator on the wheel feed handwheel. It permits the operator to set the finish dimension on the indicator by turning the wheel feed handwheel. This establishes the face of the wheel to the correct position to grind the desired dimension. Operator starts the cycle, applies the sizing gage and stops the cycle when the gage shows finish size. He moves the work table, resets the Size Finder for the next diameter and repeats the cycle.

Size Finder with Microfeed shows remarkable savings in setup and grinding time. Send us prints of your shaft for our proposal.

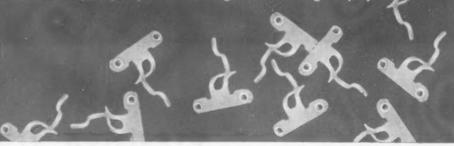
WAYNESBORO, PENNSYLVANIA

LANDIS precision grinders

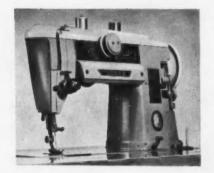
# SINGER SELECTS U.S. TOOL COMPANY PRESS ROOM EQUIPMENT



U. S. Slide Feed, Model SF-68A and U. S. Plain Stock Straightener,
Model SS-68A, in action at Elizabethport plant of The Singer Manufacturing Company



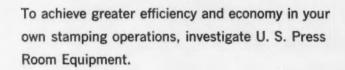
Progressive strip showing extreme accuracy maintained by U. S. Slide Feed through this 5 stage operation.



The Singer Manufacturing Company successfully combines rapid output and critical quality control in the production of stampings used in the famous SLANT-O-MATIC\* sewing machine.

In their Elizabethport, New Jersey plant, Singer uses U. S. Slide Feed, Model SF-68A, and U. S. Plain Stock Straightener, Model SS-68A, to feed coil stock into a 5 stage progressive die to produce perfect Thread Guides. Stock for the Thread Guide is 1010 cold rolled steel, in coils, 1%" wide and .045" thick. Feed length is 134".

The accuracy of this feed increases production — cuts rejections to the absolute minimum and provides the SLANT-O-MATIC machine with a finished component worthy of this fine machine.



Write for Bulletins 85M and 151M.

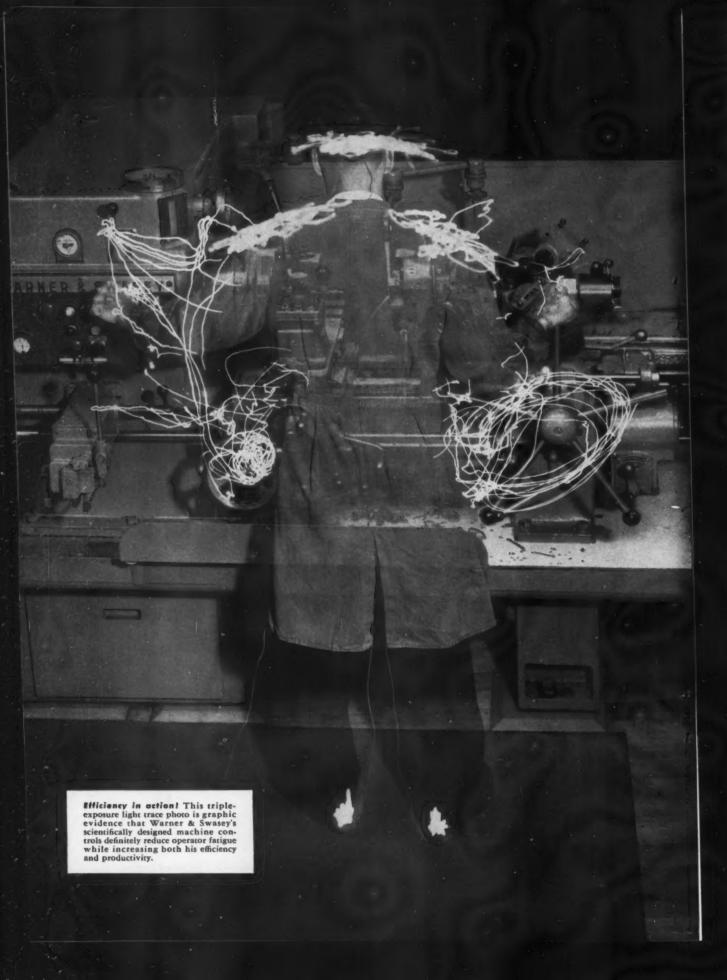




# TOOL COMPANY, INC.

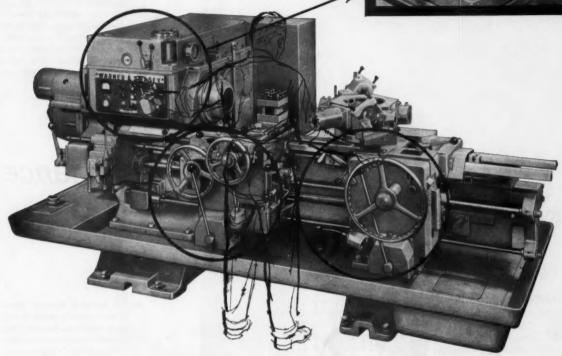
U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories "SLANT-O-MATIC IS A TRADEMARK OF THE SINGER MFG. CO.





This exclusive Warner & Swasey Speed Preselector, heart of the "zoned controls" system, enables the operator to preselect the correct speed for each cut, with just a glance-and-a-twist of the knurled knob. Proper speeds are chosen for the required cuts on the job and then marked in sequence with numbered clips placed on the top of the chart drum. Just a touch of the lever instantly shifts the machine to the next desired speed.





# Warner & Swasey Zoned Controls boost production by increasing operator efficiency

Known throughout industry as "the operator's machine", Warner & Swasey turret lathes are painstakingly designed with the human element in mind. They provide easy-to-handle operating controls, compactly arranged at convenient levels that minimize stooping and reaching — all of which contribute to increased operator satisfaction and higher production. Heart of the "zoned controls" system is Warner & Swasey's exclusive Speed Preselector — calibrated in surface feet and spindle RPM's versus work diameters — that encourages operator use of the proper spindle speeds for the particular job being machined. Additional single lever control features praised by operators include: A fast, simple change for spindle speeds; apron feed levers with "feel" control; four-way carriage rapid traverse; easy operating turret units and hydraulic collet chuck and bar feed control. For more detailed information about the adaptability of Warner & Swasey turret lathes to your particular machining problems,

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

call in our Field Representative, today.

A. Unbalance. Badly out of balance wheel is shown in grinding position on the NORTON Balancer. Pendulum weights are locked in balance correcting position for wheel previously in use. Heavy spot, shown by yellow area, tends to displace center line of wheel spindle from normal center of rotation.

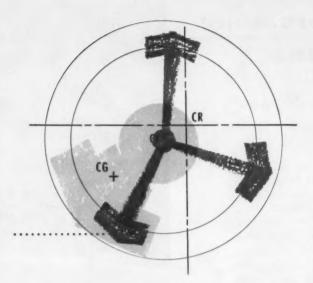
Push a button to balance

Unusual simplicity of the new NORTON Automatic Wheel Balancer introduces new advantages to unusual grinding operations. The wheel spindle and bearings are never revantages to unusual grinding operations. The wheel spindle and bearings are never re-leased from carefully fitted housing. Balancing action is developed by slight release of only the wheel assembly from nose of spindle, permitting the assembly to be carried while balancing on a floating spring shaft. Three pendulum type balancing weights give maximum sensitivity to positioning forces. Wheel assembly and balancing weights are

clamped and released automatically. Loosening a single spanner nut enables quick wheel changes. Safety interlock prevents operation of mechanism during grinding.

B. The Button is Pushed, Wheel adapter assembly moves to soft spring suspension. Assembly tries to rotate about center of gravity. Centrifugal force acting outwards from center of rotation causes pendulum weights to move away from heavy spot, as shown.

C. Balanced in 5 Seconds. Pendulum weights have moved to the correct balancing position opposite the heavy spot. Center of gravity, center line and center of rotation are now common as shown. Weights lock and wheel adapter assembly returns to grinding position.



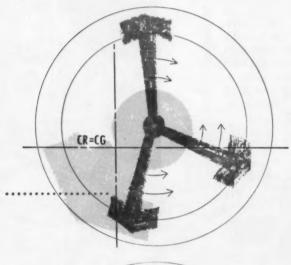
CG = Center of Gravity

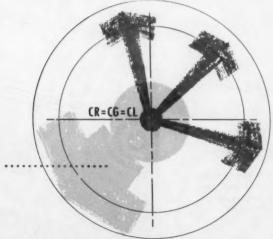
CL = Center Line of Wheel Spindle

CR = Normal Center of Rotation

# grinding wheels precisely ...

# automatically in 5 seconds





New and optional, the Norton Automatic Wheel Balancer simplifies an extra operation for extreme precision grinding.

Engineered for ruggedness and high precision, NORTON cylindrical grinders have long been recognized for producing completely satisfactory results without wheel balancing—on or off the machine.

That holds good for all but a very small minority of grinding jobs calling for the absolute extreme in precision grinding. It is for such special requirements that the NORTON Automatic Wheel Balancer is designed.

That is why it is optional on most NORTON cylindrical grinders — and that is how it teams up to produce more positive precision than has ever been obtainable with previous wheel balancing methods.

Read the diagrammed descriptions shown here. See how simply, surely and swiftly the Norton Automatic Wheel Balancer brings new advantages to wheel balancing for maximum precision grinding. For further details, see your Norton man, a Trained Grinding Engineer. Or write to Norton Company, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. In Canada: J. H. Ryder Machinery Co., Ltd., Toronto 5.



75 years of . . . Making better products . . . to make your products better

MACHINE TOOL DIVISION: Grinding and Lapping Machines - G & E DIVISION: Shapers . Gear Cutting Machines . Gear Induction Hardeners



# Another Automation First by Cross

The work-holding fixture is mounted on a precision index table which rotates 180 degrees for easy loading and unloading.

Established 1898

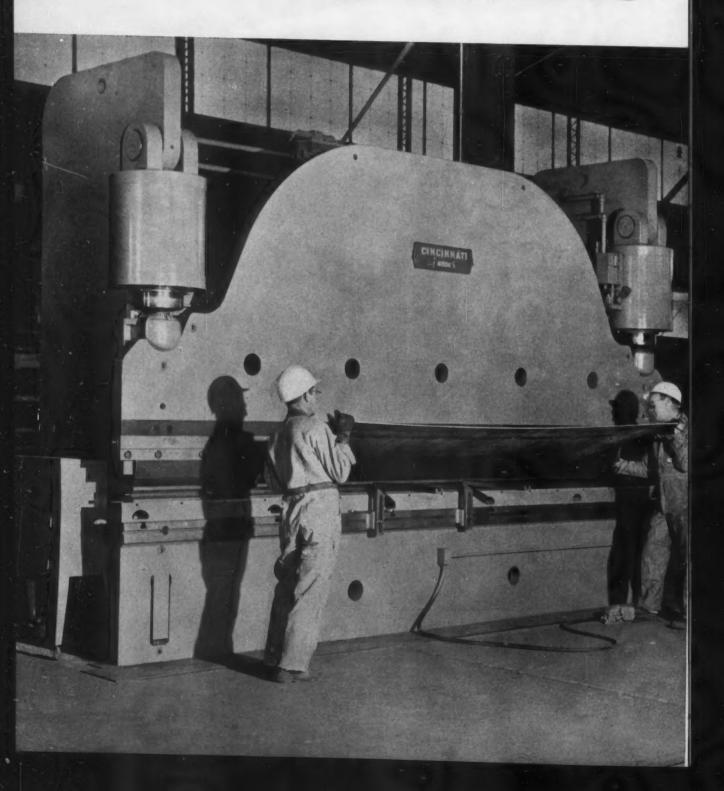
THE COLOR CO.

First in Automation

PARK GROVE STATION . DETROIT 5. MICHIGAN

CINCINNATI° HYDRAULIC PRESS BRAKE

# shortens



# set-up time



Fabricators who bend many different shapes during a day, but only a few pieces of each shape, will increase their earnings with a Cincinnati Hydraulic Press Brake. This installation at the Bannock Steel Company, Pocatello, Idaho, demonstrates the point.

Those varied shapes at the end of the machine were all bent during a single shift. Says Bannock's S. L. Cate: "We have found the flexibility of our Cincinnati Hydraulic Press Brake ideal for this application."

Set-up time is reduced by quick adjustments of stroke depth and upper stop. Dies and machine are protected by Cincinnati Automatic Overload Protection and Adjustable Tonnage Control.

See your local representative for full information on Cincinnati Hydraulic or Mechanical Press Brakes. Check our insert in Sweet's Machine Tool file.

Courtesy the Bannock Steel Company

Shapers / Shears / Press Brakes

THE CINCINNATI

SHAPER ...



Cincinnati 11, Ohio, U.S.A.

In Scotland: The Cincinnati Shaper Co., Ltd., Glasgow

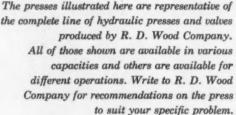
# TAKE THE LONG

### Plan for tomorrow's needs, today!

An R. D. Wood Press can be the key to better production capacity needed today . . . and equally efficient capacity in a growing economy in the years to come. In terms of today, you replace worn out equipment, increase production rates and cut excessive downtime. For the long pull, you are in a position to produce top quality products with top operating efficiency and stay on top of heavier production schedules with equipment that can still deliver . . . day, after day, after day.

Check the stamina story of R. D. Wood Presses, today. The long-range sure economy, too. Write for information on the type of press or presses that you require.

> The presses illustrated here are representative of the complete line of hydraulic presses and valves



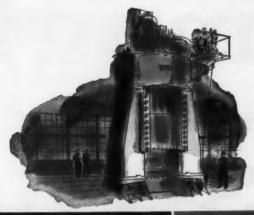


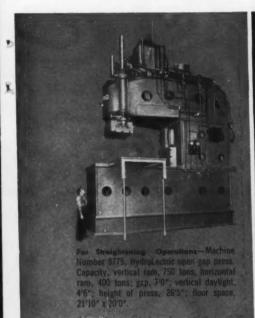
WOOD COMPANY PUBLIC LEDGER BUILDING . PHILADELPHIA 5, PENNSYLVANIA





# LOOK!

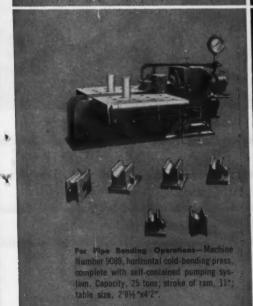






For Flonging Operations—Machine Number 8487, sectional hydraulic flanging press—also for joggling and upsetting operations. Capacity with vertical fams in unison, 300 tons; horizontal ram, 115 tons; stripper ram (in bed),115tons; gap,5'0"; yertical daylight,3'9"; height of press, 15'9"; floor space, 5'0"x14'2".







For Tube Testing Operations—Machine Number 9284, hydrostatic tube testing machine. Capacity, 4½" to 12" OD tubes, maximum tube length, 35'; test pressure, 700 to 1,500 ps; average production (12" tubes, 35' long), 30 per hour; floor space required, 5'0"x45'0".



hydraulic valve you need for a new system or updating an existing installation. Choose from a complete line of stop valves, check valves, operating valves, safety relief valves, shock absorbers, accumulator control valves and a large variety of special valves.

# imagine

buying a GRAY planer for

0.66

above basic price includes 30" x 6' planer, one rail head, electric drive and controls





- available with single or double-cutting heads
- synchro-mesh table replacer

- new Gray knee knee and rail counterbalance full pendant control of table

- Gray Safety nut full floating drive shaft quick acting saddle and slide clamps
- abutment tool aprons non-shock pneumatic tool lifters infinite feed range



technical bulletin available



# the - - - - VA V BOW-36W-42W flying scot

- square locked throughout
- flush bottom bed
- pyramid side walls on bed
- vee ways gray non-metallic ways—optional maximum capacity—table width
- 'reservoil' lubrication
   high table speeds
   duplex tables optional
   new column

- helicone transmission
   space saver drive
   table safety stop
   forced lubrication

horizontal milling and boring machines planers milling planers



# **HARDINGE Sjogren Chucks**

# Quality at Low Cost

HARDINGE-SJOGREN Speed Collet Chucks for tool room lathes, engine lathes and grinders.

Available for Threaded Nose, Cam Lock, Taper Key Drive and American Standard Spindles.

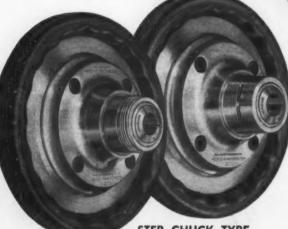




REGULAR TYPE

AVAILABLE IN FIVE COLLET CAPACITY SIZES

11/16", 13/8", 13/4", 21/4", 31/2"



STEP CHUCK TYPE
Takes Standard Spindle Nose
Accessories As Used With
Hardinge Precision Machines



HARDINGE ELMIRA. N.Y.

24

Ask Your Hardinge Representative or Local Distributor For Bulletin 8B

# **HARDINGE Low Cost Steel Collets**

Maximum efficiency—Pay for only what you use. Records show that  $82\,\%$  of all sizes used are standard 16th sizes.

Buy only the sizes you use—Hardinge Collet stocks are available in Atlanta, Boston, Chicago, Dayton, Detroit, Elmira, Hartford, Los Angeles, New York, Philadelphia (Yeadon, Pa.), Seattle, Portland, Minneapolis, Oakland, St. Louis, Springfield, N.J., and Toronto.



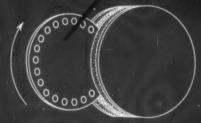
HARDINGE BROTHERS, INC., ELMIRA, N. Y. U.S.A.

# Interchangeable work carriers add profitable versatility to Gardner Disc Grinder

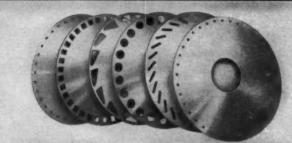
...rotary work carriers handle wide variety of parts in grinding two parallel surfaces in one operation



Gardner 2H30 precision double spindle grinder with rotary work carrier



Retary work carrier is a high production means of grinding two parallel sides in one operation. Loading and unloading can be manual or automatic.



Interchangeable rotary work carriers can be adapted for workpieces of many shapes.

 GARDNER

precision disc grinders



# Milwaylee-Matic

# "Just A Minute

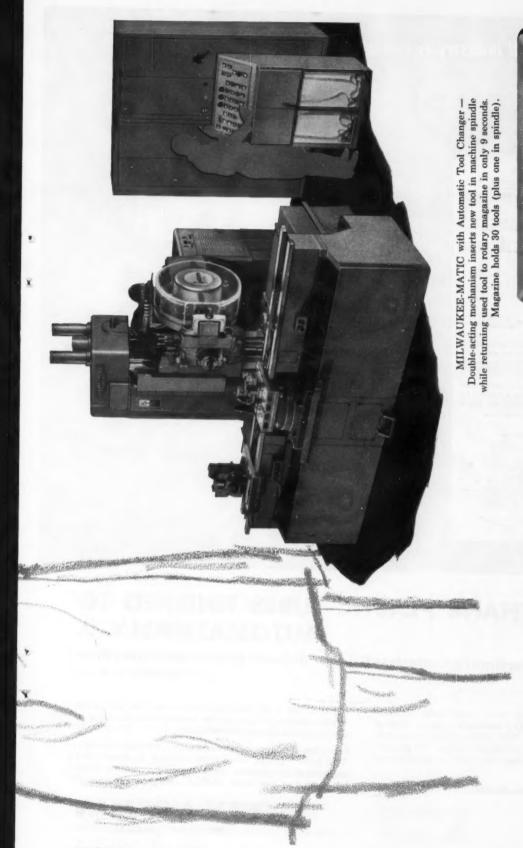
... while I mill, drill, ream, tap, bore, counterbore, countersink and spotface a part automatically."

"Sure, the job could be done on a variety of separate machines and fixtures — plus a lot of expensive setup and transfer time... but why make a project of it? With the Kearney & Trecker MILWAUKEE-MATIC, you do the whole job automatically, on a single integrated machine... under numerical control, of course. With punched tape control, each workpiece is precision-finished exactly like the one before it... accurate to tenths."

If your schedules call for small- and medium-lot runs of parts requiring a variety of machining operations, you'll want to know more about the profit-producing MILWAUKEE-MATIC . . . a new manufacturing concept. Investigate, and you, too, will be saying,

"Just a MILWAUKEE-MATIC minute . . . . while I mill, drill, ream, tap, bore . . . "

Write for complete literature file or call your local Kearney & Trecker representative today.



Numerical Control Division

# KEARNEY & TRECKER CORP.

6800 West National Avenue • Milwaukee 14, Wisconsin Phone — GReenfield 6-8300... Direct Distance Dialing Code No. 414





# SYNTHANE PLASTIC TUBES FINISHED TO AUTOMATICALLY...

VN Diversimatic Centerless Grinder delivers greater precision, finer
... costs less to buy,

Synthane Corporation cut production costs of their small (under ½ inch O.D.) laminated plastic tubing when they switched to a VN Diversimatic Centerless Grinder. This low-priced, low-maintenance VN grinder is so exact that they can rely on machine accuracy to finish the tubing O.D.

Maintained Precision Assured-Secret of VN's exact grind-

ing accuracy is its anti-friction grinding and regulating wheel spindles, which assure maintained precision in the workpiece under any conditions.

Faster Set-Ups...Increased Production...Greater Accuracy. The Van Norman Centerless Grinder is specifically engineered to produce more precision grinding work per operator per work shift...designed for in-feed

### VAN NORMAN

SPRINGFIELD 7, MASSACHUSETTS



## **EXACT TOLERANCES ECONOMICALLY**

tolerances in small diameters less to maintain

work, thru-feed work, crush form grinding and profile work. The Van Norman Centerless Grinder is rugged, and designed for heavy duty, long run production.

Send For Free Booklet-"Centerless Grinding," your local VN Franchised Distributor will be happy to discuss how VN Centerless Grinding may increase production and cut costs for you . . . call him NOW.

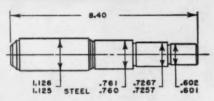
### MACHINE COMPANY

A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED



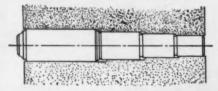
**Another typical** Van Norman centerless grinder cost-saving application

### CUSTOMER'S PROBLEM:



A prominent automobile manufacturer wanted to grind all diameters on worm shafts. The problem was more difficult because the part did not have the same hardness throughout its entire length. Automatic cycling was required as well as post-operational gauging with feed back to machine for size compensation.

### VAN NORMAN SOLUTION:



A Centerless Grinder with a Hydraulic Diamond Dresser was used to grind this part. Three operations were used because of the large amount of stock removal required, and also because of intermediate operations such as hardening and thread milling. These operations were:

1st Operation-Grind all diameters to + .012/.011 in soft state.

2nd Operation-Grind all diameters to

+ .002/.003 after hardening.
3rd Operation—Final grind all diameters to size.

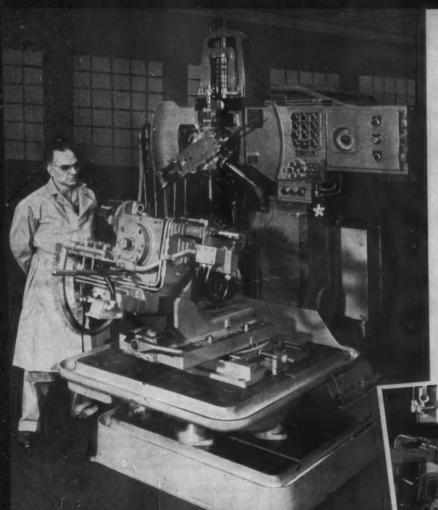
### THE RESULT:

Complete customer satisfaction. The machine functioned as planned. Production was as

1st Operation-120 pieces per hour at 100%. 2nd Operation—180 pieces per hour at 100%. 3rd Operation—240 pieces per hour at 100%. Two Van Norman machines are now in use on this job.

# Machine Time Reduced 30%

# BURGMASTER 2BR-H RADIAL



THE MACHINE TOOL



Exposition - 1960

Ingersoll special Universal Fixture completely interlocked mechanically and electrically with the Burgmaster 2BR-H Radial Turret Drill for automatically performing 5 machining operations 30 times in this 14" diameter blade cutter body. Standard machine controls permits machine to be quickly setup for handling a series of different cutters.

Burgmaster 2BR-H specially tooled by Ingersoll to process wedge screw holes in Ingersoll inserted-blade milling cutters. Machine time was reduced 30% and direct saving of 75% effected.

### World's Largest Builder of Turret Drilling Machines



"O" Manual Power Index 34" Capacity



1C Manual Power Index 36" Canacity



28 Manual Power Index 36" Capacity



28R Ram Type Radial Drill 34" Capacity



2BH Automatic Hydraulic 34" Capacity



3BH Automatic Hydraulic 11/2" Capacity



25AH Automatic Tape Controller 11/4" Capacity



2BHT-3BHT Automat Tape Controlled 34" and 11/2" Capaci

# automatic hydraulic TURRET DRIL

(at the Ingersoll Milling Machine Co., Rockford, Illinois)

A Burgmaster 2BR-H Automatic Hydraulic, 6 Spindle Turret Drilling and Tapping Machine, with a special designed Ingersoll Automatic Universal Indexing Fixture for processing wedge screw holes in Ingersoll inserted-blade milling cutter bodies, reduces machine time 30% and effects direct savings of 75%, plus additional indirect savings. Formerly cutter body holes were machined on a plain radial drill press equipped with a single manually indexed fixture, and tools individually hand changed for the various opera-

The automatic indexing fixture, which is used for a variety of different cutter bodies, is completely interlocked mechanically and electrically with the machine cycle for continuous automatic machining-free from operator control. The machine automatically locates and relief drills accurately for each cutter slot, clamps the work piece while machining, drills, c'bores, inspects hole for depth, cleans out chips and taps. These operations are performed 30 times for this 14" diameter, 30 blade cutter. The operator only loads and unloads the machine and presses a start button.

### FLEXIBLE AUTOMATION

All standard Burgmaster adjustable controls are retained in this model 2BR-H machine which permits fast set-up from one part to another. These include pre-selective spindle speeds, infinitely variable pre-selective feeds, selective rapid approach and return, skip indexing, precision depth control, and simple controls for set-up. The radial ram can be set and operated at any point through a 250° radial movement and from 14" minimum to 42" maximum extension. If desired, this machine can be equipped with a circular table and automatically controlled to permit the machining of a series of bolt circles or circular hole patterns. Special machines of this type, built up from standard components including tape controls, have also been supplied.

Regardless of your requirement, there is a Burgmaster Turret Drill that will do it faster, at less cost. Call our nearest dealer or representative.

There is no obligation.

### JOB FACTS

Machine: Burgmaster 2BR-H. 6 Spindle, Auto-

matic Hydraulic Radial Turret Drilling

and Tapping Machine.

The Ingersoll Milling Machine Com-Company:

pany, Rockford, Illinois.

Part: Ingersoll Inserted-Blade Milling Cut-

ter Body. 14" diameter with 30

Holding: Ingersoll specially designed, automatic indexing fixture with Universal

adjusting features for various types

of cutter bodies.

Material: Steel.

Operations: Automatically locates and relief drills accurately for each cutter slot, clamps

cutter while machining, drills, c'bores, inspects hole for depth, cleans out

chips and taps.

Former Method: Plain Radial Drill equipped with a simple manually indexed fixture.

Tools individually hand changed for

various operations.

Savings: Machine time reduced 30%

Direct savings in time 75%

Indirect Savings - During automatic cycle the operator works at

another station near the machine.

. Greater accuracy.

Write for bulletin describing Burgmaster 6 and 8 spindle Automatic Hydraulic Turret Drills and Radial 6 Spindle Turret Drills in detail. Thirty-minute 16mm sound film showing Burgmaster turret drills in operation including the new automatic positioning table, available from any office.



MANUFACTURING COMPANY, INC.

15001 South Figueroa Street, Gardena, California FAculty 1-3510 **DAvis 9-4158** 



BURGMASTER DIRECT SALES OFFICES:

Ridgewood, N.J. 86 North Maple Ave. Gilbert 4-3002

Chicago 25, III. 4908 Lincoln Ave LOng Beach 1-1178 Cleveland 7, Ohio 14706 Detroit Ave. ACademy 6-7030

Detroit 37, Mich. 13730 W. Eight Mile Rd. Lincoln 8-4333 San Francisco, Callf.

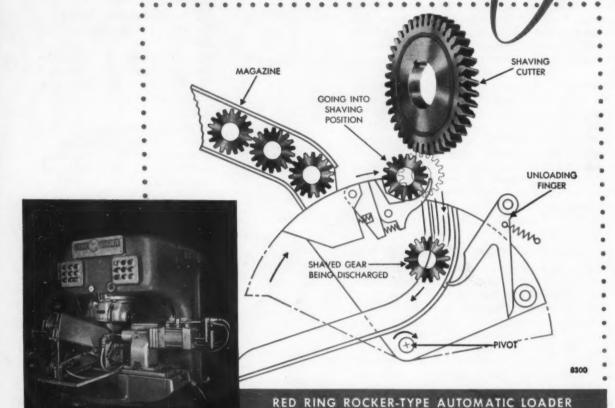
Plus dealer representatives in other industrial centers.

Circle 30-31 Inquiry Card

WHY SETTLE FOR ONLY 75%

OF THE PRODUCTION YOU CAN GET WITH

AUTOMATIC GEAR SHAVING



Production you can expect from automated gear shaving is determined by the type of automatic loader you use.

You get maximum production when the loader moves a gear from the magazine into shaving position and discharges its shaved predecessor - all at the same time. This assures maximum cutter operation.

If, on the other hand, the loading of a fresh gear has to wait until the previous gear has been discharged, shaving is delayed and you get only about 75% of the production you could otherwise expect.

The standard Universal Red Ring Gear Shaving

Machine may be automated for MAXIMUM PRODUC-TION - and without any major revisions in its design. Write for details.

(PATENTED)



DNAL BROACH MACHINE CO.

\$600 ST. JEAN . DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

# PRODUCTION POINTERS

GISHOLT

More cost-cutting IDEAS to help you

### HOW TO GET HIGH PRODUCTION EFFICIENCY ON SMALL LOTS

# Fairfield Mfg. Co. saves 30% on wide variety of short-run agar blanks

If your work includes heavy stock removal on big parts, you will be interested in this setup. Here one man with two Gisholt MASTERLINE No. 24 Automatic Chucking Lathes cuts time an average of 30% on work formerly done on three older machines!

Work includes a large variety of bevel and spur ring blanks for heavyduty automotive gears from 18" to 33" O.D. These tough steel forgings are produced in lots of 20 to 200 pieces on a 3-shift basis five days a week. The machine selected had to combine ruggedness and dependability with a fast, automatic cycle and quick changeover—all vital to profits. This is where the No. 24 shines.

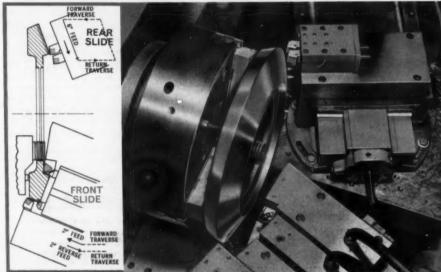
According to the user, Fairfield Manufacturing Company, Lafayette, Indiana, a 68% saving was obtained on the 24½" O.D. bevel ring gear setup shown:

FIRST OPERATION—10.5 minutes f.t.f. on the No. 24 as compared to 31.5 minutes on the older machines. SECOND OPERATION—11.75

SECOND OPERATION-11.75 minutes compared to 38 minutes.

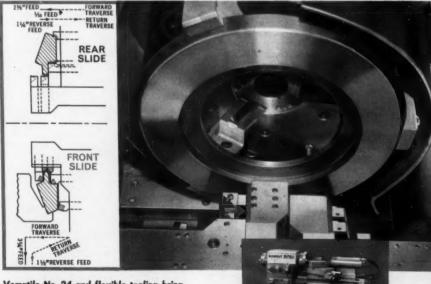
The drawings show how the various surfaces are handled by the tooling on the front and rear independent slides.

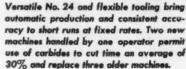
Change-over is fast—approximately 2½ hours from size to size on similar parts and five hours maximum type to type. The front carriage has an adjustable base and the front and rear independent slides are mounted on 90° angularly graduated swivel bases. Each independent slide has two forward feed rates and one reverse feed—all available during the automatic cycle. Reverse feed simplifies the holding of close tolerances and provides required fine surface finish.



Operation 1: Drawing shows surfaces machined with tooling setup at right.

Operation 2: Drawing shows surfaces machined with setup at right.





For complete information on the Gishelt No. 24 Automatic Lathe, circle No. 715 on Reader Service Card.



# HOW GLOBE OIL TOOL GROOVES ROTARY ROCK BIT CUTTERS 500% FASTER

### One basic tooling setup handles two operations on wide variety of similar parts

One of the toughest jobs in manufacturing rotary rock bit cutters is the machining of deep grooves in the tough steel forgings. The machine must be rigid and powerful for maximum metal removal and long tool life. It must also be versatile to economically handle a variety of sizes, ip small lots.

To meet all these requirements, Globe Oil Tool Co., Los Nietos, California, selected a Gisholt Simplimatic Automatic Lathe. Not only did the Simplimatic replace three older lathes, it reduced machining time 80%.

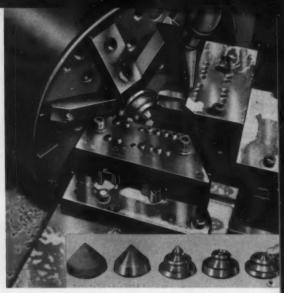
Each cutter requires two operations. Tooling is carefully planned so that one basic setup will handle both operations on all sizes from 5% to 18. Lots range from 25 to 1000 pieces.

The first operation consists of rough- and finish-turning the cone

Second operation setup for grooving the 61/6" steel rotary rock bit cutter shown at far right, inset. Other parts, from left to right: rough forging; after first operation; three different cutter types produced from the one size forging.



O.D. with tools on the front and rear independent slides. The second operation, grooving, is divided between the front and rear independent slides. The slides operate simultaneously during both operations. F.t.f. times, for the 61/8" cone shown: first operation, 1.2 minutes; second operation, 2.5 minutes.



One basic setup handles all sizes and types. Swivel-base tool slides are quickly set for correct cone angles. Open-face tool blocks permit addition or removal of tools.

For complete information on the Simplimatic, circle No. 716 on Reader Service Card.

### FOUR-STEP BALANCING OPERATION COMPLETED IN ONE HANDLING

## Work is driven from below to eliminate belt-lifting for faster production

Every balancing operation consists of four basic steps: location of angle; measurement of amount; unbalance correction; inspection. This 1S Balancer setup, in the plant of a well-known automotive manufacturer, demonstrates how all four steps can be completed in one handling.

The workpiece is a 9-lb. alternator rotor assembly. It rests on top of the driving belt, eliminating the need to raise the belt to load and unload.

Because Gisholt Balancers indicate the angle and amount of unbalance electrically in each correction plane, there is no guesswork by the operator. The strobe lamp shows the exact angle of unbalance on a numbered disc. The amount meter is calibrated in units of depth of a ½" drill starting at a 2¼" radius.

An air clamp arrangement lifts the work out of the supporting fixture and holds for correction drilling. Two drill spindles drill at the indicated angles to the depths shown on the amount meter, correcting for balance in each plane.

Driving work from below eliminates belthandling, ups production to 44 parts per hour at 80% efficiency. This includes locating, measuring, correcting and inspecting for balance in each plane. Operator about to make drill correction in right correction plane. He matches meter reading with depth dial on drill head, eliminating guesswork. Special work-holding and thrust device prevents damage to supporting fixture.

For complete information on Gisholt Balancers, circle No. 717 on Reader Service Card.





Strobe lamp, focused on numbered disc on left hub of part, clearly shows exact angle of unbalance in each plane. Note direct-reading amount meter, electrically calibrated in units of drill depth to minimize operator effort.

#### HOW CRANE LTD. TURNS OUT NEW VALVE LINE AT PEAK EFFICIENCY

Crane Ltd., Montreal, Quebec, Canada, in setting up to produce a new valve line, investigated the many claims being made for latest automatic machining methods. Crane's work included intricate contours on both bar and chucking jobs in a wide variety of sizes. The two setups shown here are giving Crane the cost-cutting efficiency it hoped to find.

#### Gisholt No. 5 Automatic Ram converts quickly to bar or chucking work

The tooling setup shown at right, on a MASTERLINE No. 5 Automatic

Ram, is typical.

A special octagonal turret and front and rear tools on the cross slide provide ample tooling stations to complete most parts in a single operation. Spindle speeds and machine functions such as bar feed, collet operation, turret index, traverse, feed selection, turret return and cross-slide operation are preset. Reduced pressure for threading, and a die-head cocking device are also preset.

Setup is as fast as for a handoperated ram type turret lathe. Only minor tool adjustments and tool changes are needed for the entire

work range.

On bar work, the lathe requires

attention only when stock is exhausted or when chips must be cleared. On chucking work, the operator loads, starts the cycle and unloads. In addition to fast machining, optimum tool life and consistent quality at fixed production rates, the automatic cycle allows the operator to do other work.

Inset shows typical bar jobs. Each is produced in one automatic operation.

Tooling setup for part at right, an inside screw union bonnet for a 1½" cast steel, 600 p.s.i. gate valve, produced from 3", cold rolled C-1026 bar stock.

A retracting locator (A) acts as a stock stop. Turret tools turn the O.D.; drill, bore, form, face, chamfer and thread the O.D. A plunger (B) recocks the die head during indexing. O.D. radius is formed from rear of cross slide. Finished part is cut off from front of cross slide, and cycle repeats. Time, 4.2 minutes f.t.f.

Get the facts on the Gisholt AR (Automatic Ram) Turret Lathe. Circle No. 718 on Reader Service Card.







Inset shows two typical parts. Each is machined at both ends in one chucking. The ½", 600 lb. cast steel gate valve body at the right of the inset is handled with the setup shown. First, one end is machined, requiring one complete index of the octagon turret. The work is indexed 180° and another complete index of the turret finishes the other end. Total time, only 3.20 minutes f.t.f.

Tracing provides highest accuracy and eliminates chance of error on contours, etc. Since all diameters are finished with one tool, only one dimension needs to be checked greatly simplifying inspection. Again, the automatic cycle frees the operator for other work.

For complete information on the Fastermatic, circle No. 719 on Reader Service Card.



ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

## Fastermatic with JETracer handles I.D. contours automatically

Intricate contours on opposing inside diameters of over ten different parts are handled automatically on a Gisholt MASTERLINE 2F Fastermatic. These include five sizes of 600-lb. cast steel gate valve bodies ranging from ½ " up to 2".

In selecting a machine for this work, Crane Ltd. wanted the versatility of tooling usually found only in a manual turret lathe, and automatic cycle production. Also, the machine had to handle a wide range of parts in long and short runs with minimum tooling and quick change-over. All these requirements were met by a 2F Fastermatic equipped with a turretmounted JETracer slide tool and an

indexing work-holding fixture.

Here are other features that provide the versatility to handle the wide range of work economically:

Octagon Turret—provides maximum tooling stations permitting complex work to be completed in one chucking on most parts; Automatic Spindle Positioner—to reduce loading-unloading time;

Automatic Forward-Reverse of Spindle
—for all types of threading work
using die-heads or taps;

Turret Threading Attachment—to produce high-quality, close-tolerance threads:

Two-Speed Motor—to assure proper surface speeds for turning, boring, threading, forming, etc.;

Turret Facing Attachment—to actuate turret-mounted recessing tools.

The most unusual feature of this setup is the use of a turret-mounted JETracer slide tool, operated automatically during the machining cycle. The flat template is held in a sliding bracket that obtains length location by engaging a stop bar on the side of the overhead pilot bar. Continued forward feed of the turret saddle causes the tracer stylus to follow the template contour, governing movement of the single-point tool on the tracer slide.





Operator inserts C-clamp on draw rod and holds brake drum against adapter to centralize and locate while actuating foot control to clamp the part. During the automatic cycle, .003" to .005" stock is removed and a "controlled" surface finish of 50 micro-inches RMS is produced. Time, 15 seconds f.r.f. Inset left, bored part; right, part after Superfinishing operation that eliminated intermediate grinding.

### SUPERFINISH ELIMINATES GRINDING AND IMPROVES BRAKE DRUM QUALITY

#### Superfinish provides greater area contact, removes smear metal for longer life

Superfinish saves in many ways: Equipment cost is low. "Controlled" finishes are obtained in seconds. Part geometry is improved. A better surface is produced, with "peaks" removed, leaving plateaus and valleys for greater area contact. Surface smear metal is "scrubbed" away, exposing true base metal for longer service life. Superfinishing can also be used for stock removalas well as for fine finish. In many cases, parts are turned or faced and then Superfinished—eliminating intermediate operations.

All these points are demonstrated by this setup on a Gisholt Brake Drum Superfinisher. The workpiece is a cast iron drum with an 11" diameter 21/16"-deep braking surface. It comes to the machine bored within limits of plus .005", minus .000", and has a surface finish of approximately 250 micro-inches RMS.

It is loaded with the open end towards the headstock. An adapter locates and centralizes against the inside of the mounting flange. AC-clamp is slipped on a draw rod extending through the small bore to hold from the other side. When the automatic cycle starts, two sets of Superfinishing stones expand, contacting the I.D. One set of stones roughs, removing from .003" to .005" of stock. The other set finishes, producing a "controlled" 50 micro-inch RMS surface. Time, only 15 seconds f.t.f.

Superfinish can save and improve quality for you, too. Gisholt has a complete line of general-purpose, high-production or special Superfinishers to meet your every need.

For complete information on Superfinishing, circle No. 720 on Reader Service Cord.

### ACME INDUSTRIAL THREADS STAINLESS 467% FASTER, ELIMINATES REJECTS WITH CRI-DAN

#### Threading an I.D. taper up to a shoulder eliminates heattreat distortion problem

Producing a 20 TPI NF Class 3 thread right up to the shoulder in the bore on the hex end of this 440C stainless spool valve presented a host of problems—problems that could be handled economically only on the Gisholt CRI-DAN B.

Acme Industrial Co., Chicago, Illinois, was producing this part in lots of 4000 pieces, using taps. First a standard tap...then a bottom tap at 15 pieces per hour for each operation. Breakage was excessive. After tapping, the part was hardened and the threaded end was annealed. Shrinkage at the base of the bore resulted in a tapered thread. This required another bottom tapping and often resulted in more broken taps. Rejects ran as high as 20%.

A CRI-DAN B Threading Lathe solved the problem by producing a tapered thread with the large diameter at the shoulder at the back of the bore. Shrinkage after hardening and annealing produces the desired straight thread. The thread is completed in 22 automatic passes with diminishing in-feed, for fine finish and easy holding of the .4675" go, .4701" no-go tolerance. Production, 35 pieces per hour. A single-point carbide threading tool is used, which produces about 75 parts per grind.

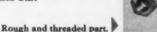
5.03 minutes saved per part...tap breakage and rejects eliminated. Straight, tapered, multiple-start, left- or right-hand threads are standard with CRL-DAN. Here a single-point carbide tool is used to thread faster, more accurately, and at less cost than any other method.

For complete information on CRI-DAN Threading Lathes, circle No. 721 on Reader Service Card.





Operator uses gage for quick "on-center" positioning of threading tool. Part is centered and located for length in bushing in bore of special chuck having three slotted jaws. The slots retain a loose ring. Pressure distorts the ring, causing three swivel jaws to centralize, grip and drive on the hex O.D.







No. 5-660 760

The Gisholt Round Table represents the collective experience of specialists in the machining, surfactinishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLL

Printed in U.S.A.

Madison 10, Wisconsin

Turret Lathes • Automatic Lathes • Balancers • Superfinishers • Threading Lathes • Packaging Machines • Masterglas Moldod Plastic Products



Dual-bolster design permits tooling up of one bolster (left) while press is producing parts from die on the other. This press, at the A.O. Smith Corp., Milwaukee, Wis., has proved the economy of this design for the past 2 years.

## Press downtime...cut from hours to minutes with the Hamilton dual bolster press

Hours — sometimes days — formerly wasted in changing dies can be used productively with the Hamilton sliding dual bolster press. While the operating bolster and die are turning out parts, the second bolster is being tooled up for the next production run. Pushbutton-controlled hydraulic motors

position the standby bolster fast and surely for rapid startup and production of the next part — changeover time is a matter of minutes only.

A 1250-ton, 2-point, top-drive press equipped with two sliding bolsters installed at a Midwest automobile parts plant is proving the economies of this innovation—on parts up to 12 ft. long. Reduced parts inventory, meeting schedules on time, and fewer presses needed to accommodate frequent die changes are among the benefits resulting. For detailed information on the new Hamilton dual bolster press, write Dept. P-1.

#### BALDWIN · LIMA · HAMILTON

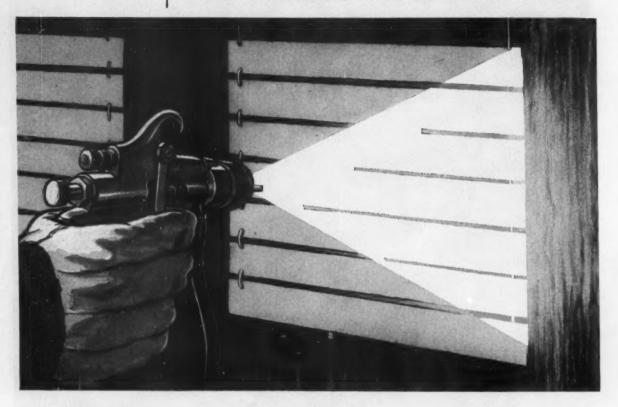
Industrial Equipment Division · Philadelphia 42, Pa.



To avoid spray booth troubles

## ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE . OVER 250 FIELD SERVICE MEN . OVER 160 MATERIALS



## Oakite curtain water treatment takes the "tack" out of overspray

Just a few inexpensive ounces of the right Oakite additive in the spray booth water curtain save hours of clean-up time. The reason: Oakite chemicals surround each droplet of paint with an "anti-stick" film that keeps spray from adhering to walls, pumps, lines and water nozzles. Paint that doesn't settle or float immediately will still wash through the system—but it won't stick, won't clog the sprays. The result: a water curtain without gaps, a smooth running system, no unplanned downtime.

There's a full line of Oakite water additives ... one to match any of the countless paints, enamels and organic coatings. The *right* one will help paint sink to the sump... or float to the surface for skimming off... or overcome special hard water troubles... or combat foaming problems. What's your problem? Ask the

Oakite man to make free tests in your paint spray booth. They won't interfere with production. They may save you hours of spray booth downtime. Bulletin F-9443 tells more. Write Oakite Products, Inc., 26 Rector Street, New York 6, N. Y.

it PAYS to ask Oakite



Technical Service Representatives in Principal Cities of U. S. and Canada

### Right before your eyes...

A 27% (or more) INCREASE in LATHE PRODUCTIVITY!





Push-Button Zeroing . . . you're instantly and automatically ready to measure off the next distance.

The DISTOMETER, a totally new precision instrument, greatly increases lathe output...

Because -

- It provides a much faster, more convenient and more reliable means of spotting tool position and measuring longitudinal cutting distance than any other available device.
- It has motorized, Push-Button Zeroing. Lets you reference instantly at any point in the carriage travel for continuous measurement to any other point.
- It puts accurate, well magnified, man-size readings in front of the operator so he can follow progress of the tool and know instantly when it has covered the required distance.
- It requires no set up, no positioning, no mastering. Ready to measure <u>directly</u> at the touch of a button.

ANY MANUALLY OPERATED LATHE . . . OLD OR NEW . . . BIG OR SMALL . . . CAN USE THE DISTOMETER PROFITABLY!

Write for brochure.

FEDERAL PRODUCTS CORP. 6116 Eddy Street, Providence 1, R. I.

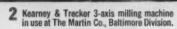
Ask FEDERAL First

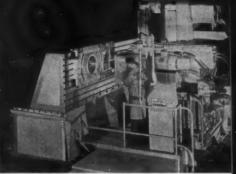
FOR RECOMMENDATIONS IN MODERN GAGES . .

Dial Indicating, Air, Electric, or Electronic—for Inspecting, Measuring, Sorting, or Automation Gaging

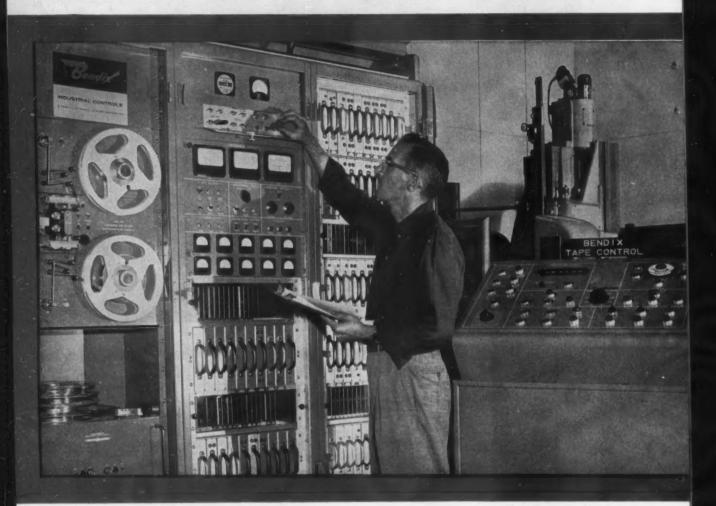


Bullard vertical turret lathe similar to machine now being equipped with numerical controls for use by A.E.C.





3 Kearney & Trecker 3-axis A.M.C. profiler in use at Norair Div. of Northrop Corp.



Bendix Continuous Path Machine Control Unit.

BETTER TOOLS THROUGH TEAMWORK

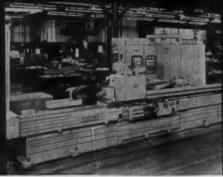


7 Kearney & Trecker 4-axis profiler in use at Columbus Div. of North American Aviation, Inc.









5 Ex-Cell-O rotary profiling machine in use at Ex-Cell-O Corp., Detroit.



6 Pratt & Whitney 3-axis Numeric-Keller in use at Pratt & Whitney Co.

TEAM REPORT: Bendix Numerical Controls for Machine Tools

## MACHINE TOOLS WITH BENDIX NUMERICAL CONTROLS ROLL UP 190,000 PRODUCTION HOURS

Machine Tool Builders, Bendix, and Machine Tool Users Team Up To Cut Production Costs and Lead Time With Numerical Controls.

Bendix Continuous Path Numerical Controls have logged more than 190,000 hours (95 work years) of production time on a wide variety of machine tools. The photos and captions on these two pages show a few of the applications of Bendix Numerical Control on machine tools.

Bendix considers numerical control a Complete Manufacturing Concept and offers the user and machine tool builder experience in Electronic Data Processing, Electronic Controls and Machine Tool Servo Design. This concept achieves practical reality through the cooperation and teamwork of the machine tool builder, Bendix, and the machine tool user. And Bendix has more working experience in the field of continuous path control with machine tool builders and major users than any other electronic controls manufacturer.

Bendix teamwork experience gives the manufacturer who needs machine tools a marked benefit: it permits him to plan ahead *now* by specifying Bendix Numerical Controls for his machine tools. Regardless of product configuration or machine tool preference, Bendix can deliver numerical controls that have been proved in use.

Watch for announcement soon on positioning controls by Bendix.

#### **Industrial Controls Section**

21820 Wyoming, Detroit 37, Michigan



8 Ex-Cell-O cam milling machine in use at Hamilton-Standard Div. of United Aircraft Corp.

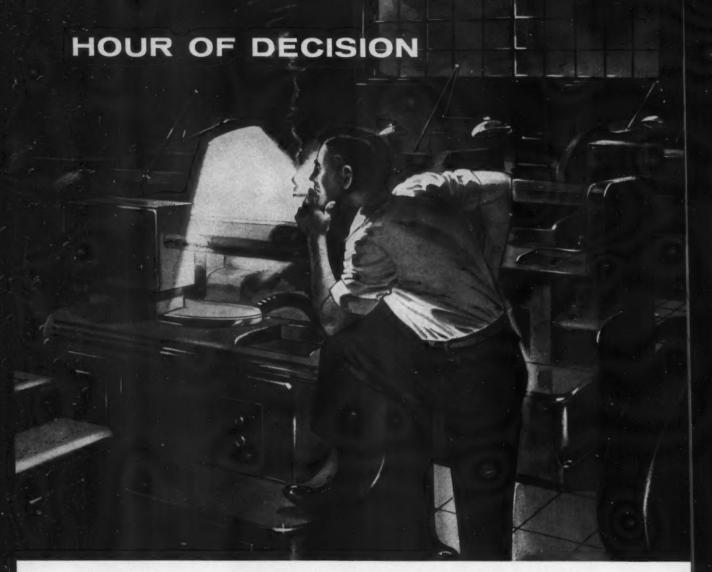
9 Ex-Cell-O Model 922 precision template grinding machine in use at ACF Industries.

10 Kearney & Trecker 2-axis rotary profiler in use at Pratt & Whitney Aircraft Div. of United Aircraft Corp.









**15 THIS YOU?** How many times, after the call bell stops clanging, the customers stop phoning, and people stop asking questions, do you walk into the quiet shop to face up to the really vital decisions?

"How can we compensate for the rising costs of materials, overhead, payroll, maintenance?" "How can we keep producing the exacting tolerances, finishes, and quality our markets are demanding?" "How can we improve our production efficiency so that our narrow profit margin will not disappear altogether?" "How can we meet and beat the increasing world-wide competition in our field?"

One proved answer to these questions is the logical replacement of obsolete, inefficient machines. THE MACHINE TOOL EXPOSITION — 1960 will back

up this fact with 11 acres of the latest developments in machine tools. Can you afford to miss seeing new, faster machine tools that will produce more efficiently . . . new, better methods that will cut satisfying chunks out of metalworking costs . . . new, ingenious ideas that will help you produce more quality for less cost?

Tool-up for the Sixties. Plan *now* to attend the largest, single-industry exposition ever held in the United States. Have your key personnel on hand, too. It's a once in five years chance to examine the latest technological advancements in automation through numerical controls and see why Modern Machine Tools = Production Efficiency!

Also see the PRODUCTION ENGINEERING SHOW on the Navy Pier. One registration covers both.

FORMULA FOR TOMORROW

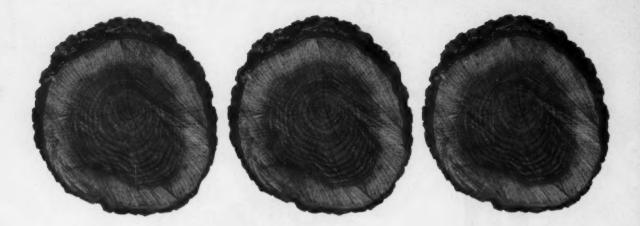


International
Amphitheatre
Chicago, Illinois
Sept. 6-16

### THE MACHINE TOOL EXPOSITION - 1960

NATIONAL MACHINE TOOL BUILDERS ASSOCIATION

2139 Wisconsin Avenue, N.W. . Washington, D. C.



### POSITIVE DUPLICATION—EVERY TIME!







These "fingerprints" of a tree will always duplicate characteristics by which an expert can positively identify all cross-sections from the trunk of that tree. But you don't have to be an expert to get Positive Duplication—when you use these CINCINNATI ® SEGMENTS, and all CINCINNATI GRINDING WHEELS.

#### YOU GET (PD) UNIFORMITY

Cincinnati supplies you with wheels of uniform excellence, because of the unique ® manufacturing process which involves 36 separate and unvarying quality controls.

Every step, from grain mix to final inspection, is directed to uniformity of product. For example, while vitrified wheels are being fired, automatic recording analyzers keep sampling the kiln atmosphere to maintain desired oxygen content throughout the firing process.

#### RESULT: DEPENDABLE PERFORMANCE

You can depend on M WHEELS because each reorder

wheel gives you exactly the same good job as the original.

Using ® WHEELS you will find production going up, and costs going down . . . to stay! This is the promise—and the performance—of Positive Duplication.

#### CALL CINCINNATI TODAY

Solve your grinding problems with the help of specialists trained by the Cincinnati Milling Machine Company. Their wide experience in job set-ups and grinding operations is at your service.

Just call your CINCINNATI ® GRINDING WHEELS Distributor or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.



A PRODUCTION-PROYED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

\*Trade Mark Reg. U.S. Pat. Off.

For more data circle this page number on card at back of book



for speed and accuracy in production it pays to use UNIVERSAL DRILL BUSHINGS



UNIVERSAL ENGINEERING COMPANY . FRANKENMUTH 2, MICH.

214



#### A Little Puff of Air Is All It Takes

... to cut tooling costs 71%, increase production 400% and entirely eliminate your jig costs!

When you inspect the new AMERICAN Positioning Table, you'll find a brand new concept in numerical control!

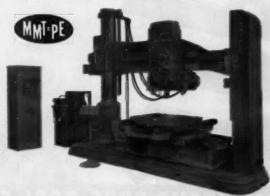
No steel fingers feel and wear the Mylar tape. Entire blocks of information are read at once ... by low pressure air ... instantly positioning and holding the table without mechanical clamps.

In addition to extremely fast and error proof positioning, the American Positioning Table gives you accuracy of ±.00025" and repeatability of ±.00005" without fail!

Designed by The American Tool Works Company in conjunction with Sperry-Gyroscope electronic engineers, your American ultra-precision Positioning Table is simple to operate and entirely safe from human error.

Ask your American Distributor about "Toolease", our leasing plan under which an American Positioning Table and American Hole Wizard Radial Drill can improve your production . . . while it pays for itself! Or write Section 162 at the address below.

Ask for Bulletins 700 and 801.





THE AMERICAN TOOL WORKS COMPANY

PEARL STREET AT EGGLESTON AVENUE . CINCINNATI 2, OHIO

## ARMSTRONG

### TOOL HOLDERS

#### **A Correct Tool for Every Lathe Operation**

You can save time (and money) by ensuring that your machine tools are equipped with adequate numbers of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for every standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

ARMSTRONG Tool Holders are long-lasting tools. They are strong beyond need, handy and efficient, profitable to use, and are readily available from your local ARMSTRONG Distributor.

Check over your ARMSTRONG Tool Holder needs.

Write for literature

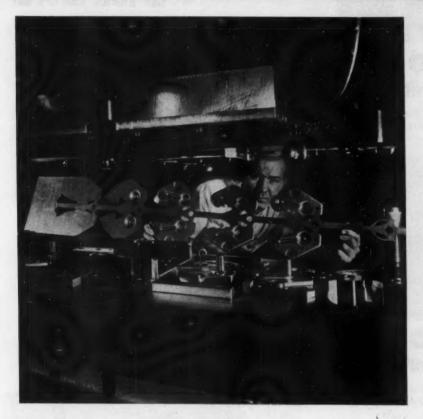






## Tool Steel Topics





Another report on Lehigh H tool steel—

"good machinability . . . very low distortion"

#### 7-STAGE DIE FORMS AUTOMOTIVE DECK HINGE PART

This 7-position progressive die of Bethlehem Lehigh H tool steel was made recently by Hillside Tool & Die Company, Roseville, Michigan, for the production of an automotive deck hinge part, from 13-gage sheet steel. The die, made from Lehigh H supplied by our local distributor, Peninsular Steel Co., Detroit, was hardened to Rockwell C 60. It was used in a 400-ton press.

When asked about the performance of the tool steel, a Hillside engineer reported, "We like Lehigh H in jobs of this type because of its good machinability, and its very low distortion during heat-treatment. The die was placed in service with hardly any stoning necessary."

Bethlehem Lehigh H (AISI D-2) is our easy-machining, high-carbon, highchrome grade of air-hardening tool steel. It has outstanding wear-resistance, due to its excellent carbide distribution.

Your Bethlehem tool steel distributor can give you full details on Lehigh H... and he has many sizes in stock.

### BETHLEHEM TOOL STEEL ENGINEER SAYS:



Here's how to shrink-fit tool Inserts

Shrink-fitting of tool steel inserts, commonly used in improving the service life of tools, is most applicable to rings and cylinders used in heading and drawing operations, where the tools can be shrink-fitted into large retaining rings. The shrink-fit sets up radial compressive stress in the tool. This serves to oppose radial tensile stress set up in service, thereby improving the performance over solid tools which are not pre-stressed.

Here's how to do it:

- 1. The retainer should have adequate diameter and strength to provide the stresses required on the tool insert. Generally, an alloy steel capable of hardening to 300-400 BHN is used. Shock-resisting tool steels, heat-treated to Rockwell C 48-52, are recommended for heavy-duty applications. The OD of the retainer should be at least twice, and preferably three times, the ID.
- 2. Allow for a shrink-fit of .003/.004 in. per in. Thus the OD of the insert is .003/.004 in. per in. larger than the ID of the retainer into which it is to fit. These dimensions must be maintained to obtain the benefits of shrink-fitting.
- 3. It is important that the OD of the insert and the ID of the retainer have a smooth finish, preferably produced by grinding.
- 4. Heat the retainer to a temperature sufficient to cause the expansion required in assembling the insert. Do not exceed the tempering temperature used in heat-treating the retainer. If necessary, the insert may be sub-zero cooled, to help provide the proper clearance for assembly.
- 5. After assembly of the parts, the assembly should be cooled rapidly. This will prevent over-tempering of the insert by heat transferred from the retainer.



## Model 50 is more accurate

3/32" to 1-1/16" range—.100" per collet . . . maximum runout .001", when properly mounted.



## Model 50 is easier to operate

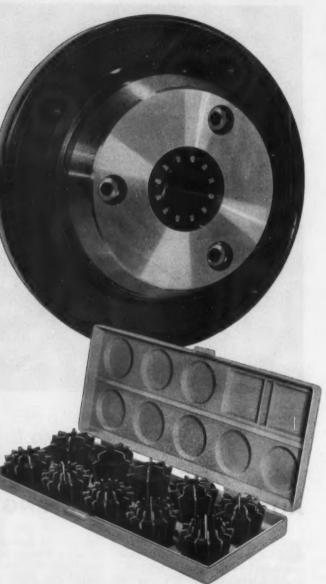
All opening and closing is done at the spindle nose. Rubber-Flex collet changing is quick and easy.



## Model 50 increases lathe capacity

No draw bar needed. The full diameter of the spindle through hole is available for chucking larger sizes.

# New MODEL 50.. collet chuck equips a lot more



\$**70**00 for the chuck

\$65°° for the collets

## . world's most modern your lathes to do for a lot less!

Atlas, Clausing, Delta, Logan, Sheldon, and South Bend lathes and others of similar power and capacity now give top performance when equipped with the new Jacobs Model 50. Improve performance of your lathes. Increase spindle capacity as much as 42%. Get greater accuracy and stronger grip. It's easy and inexpensive with new Model 50 and its companion Rubber-Flex collets.

#### CONSIDER THESE FEATURES ...

#### Gripping Power

Model 50 is made for heavy duty turning. It has tremendous gripping power.

#### Accuracy

Model 50 is factory tested—maximum runout .001" T.I.R. at the nose, when properly mounted.

#### Thin Walled and Fragile Work

Always parallel Model 50 Rubber-Flex collet jaws permit chucking of tubing and fragile materials without crimping or scoring.

#### Range

The 10 Rubber-Flex collets in the 500 Series, developed especially for use with Model 50, cover a greater bar stock range than 63 old-fashioned steel collets. You can chuck any bar between 3/32" and 1-1/16" with this set of 10 collets.

#### Capacity

Model 50 eliminates capacity-wasting draw bar. You can increase spindle capacity up to 42%.

#### Adapters

Model 50 adapters are fully machined for immediate mounting, Available in all popular threads and American Standard L00 taper.

#### · Price

Model 50 prices are revolutionary!

\$70.00 for the chuck.

\$65.00 for the complete set of 10 collets.

MODERNIZE YOUR LATHES WITH JACOBS MODEL 50 AND RUBBER-FLEX COLLETS. YOU CAN'T AFFORD NOT TO!

See your Jacobs industrial supply distributor. Give him the opportunity to prove these fantastic facts with a convincing demonstration at your desk! Call him today.



Jacobs

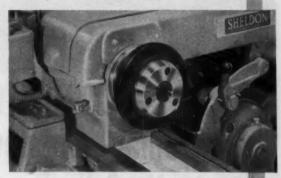
The Jacobs Manufacturing Co., West Hartford 10, Conn.

MACHINERY, June, 1960



## Model 50 develops more torque

The Jacobs Rubber-Flex collet has a stronger grip...extra long, always parallel collet bearing surfaces.



## Model 50 mounts directly on spindle

Model 50 is furnished with mounted adapter. No threading necessary.



## Model 50 is quicker to operate

Handwheel makes chuck easy to open and close. Hex wrench locks fast and easy at the nose.



## seems too difficult for this remarkable new Moore No.3 Jig Borer"

...writes A. A. Zeise
of Tool Products Company, Minneapolis, Minnesota

"Our ability to offer the finest work on the best equipment has consistently rewarded us with gratifying success and steady growth during the past 13 years. With Moore equipment we have always been able to assure highest accuracy and top quality in our day-to-day to-drown work."

to-day toolroom work.

"And now, with the recent addition of our Moore No. 3 Jig
Borer, we are hitting a new high in precision—constantly achieving tolerances of .000050 (50 millionths). Located in our temperature controlled room, no task seems too difficult for this remarkable
Moore machine."

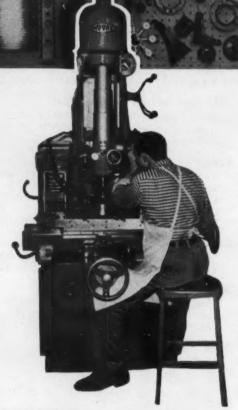
You, too, will easily break the "tenth" barrier—boring, drilling, reaming and spotting holes in dies, jigs, and production parts—with the new Moore No. 3 Jig Borer.

It offers more precise positioning tolerances ... all hardened, ground and lapped ways...no gibs...no overhang... improved drive... and a speed range of 60 to 2250 RPM.

Write for illustrated brochure. Ask also for information on the new No. 3 Jig Grinder, which locates and grinds holes to less than a "tenth."

#### MOORE SPECIAL TOOL COMPANY, INC.

734 Union Avenue, Bridgeport 7, Connecticut





HOLES, CONTOURS AND SURFACES, Moore's authoritative book, tells how to produce tools, dies and precision parts the modern way. 424 pages, 495 illustrations. \$5 in U. S. A., \$6 elsewhere.

ADD



TO YOUR TOOLROOM

JIG BORERS . JIG GRINDERS . PANTOGRAPH WHEEL DRESSERS . PRECISION ROTARY TABLES . HOLE LOCATION ACCESSORIES





FOR 100% OF ALL METAL CUTTING JOBS

Production-proved products of The Cincinnati Milling Machine Co.

CIMCOOL 52 Concentrate — The pink fluid which covers 85% of all metal cutting jobs. CIMPERIAL — Newest in the famous, industry-proven line of CIMCOOL Cutting Fluids. CIMPLUS — The transparent grinding fluid which provides exceptional rust control. CIMCUT Concentrates (AA, NC, 55) — For every job requiring an oil-base cutting fluid. ALSO — CIMCOOL Tapping Compound — CIMCOOL Bactericide — CIMCOOL Machine Cleaner.

For full information on the complete family of CIMCOOL Cutting Fluids, call your CIMCOOL Distributor. Or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

\*\*Trade Marks Reg. U. S. Pat. Off.

# STOP

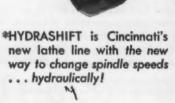
these men from stealing your profits.

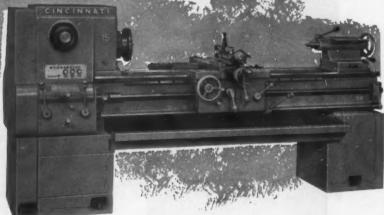
You know about this fellow . . . he's stealing "cash", and you do try to stop him.

But YOU cause this theft . . . you force this man to steal your profits . . . make him add to labor and burden costs on most lathe jobs, no matter how hard he works.

The solution is easy.

make your operator a cost-reducer on ALL of his lathe jobs—shift him to HYDRASHIFT\* Here's why......





Compare the machining of this typical lathe job,

two steps

and two necks

on the new HYDRASHIFT . . . on a conventional lathe



Operator waits for machine to complete the step cuts.



As second step is being cut, operator turns the dial to speed required for the necking cut.





0

Step cuts completed, operator changes to necking tool (he had it lying on the convenient Tray-Top) and positions tool for cut.





Step cuts completed, operator changes to necking tool and positions tool for cut.



Operator engages spindle lever and cuts the neck—without leaving apron.





Operator goes to headstock, shifts various levers to change to spindle speed for necking cut.



Necking cuts completed, operator changes tools for next workpiece.





Operator returns to apronengages spindle lever, and cuts the neck.

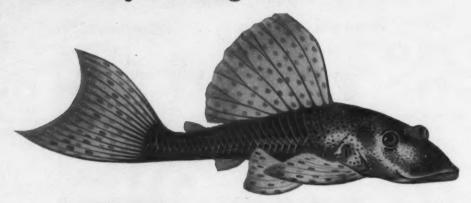
Don't force your lathe operators to steal profits from your pockets—take a look at the new Cincinnati HYDRASHIFT Lathes at your nearby Cincinnati Lathe and Tool Dealer's showroom. If you can't reach him immediately, wire collect!



CIN INNATI WITHE AND TOOL CO. CINCINNATI 9, OHIO

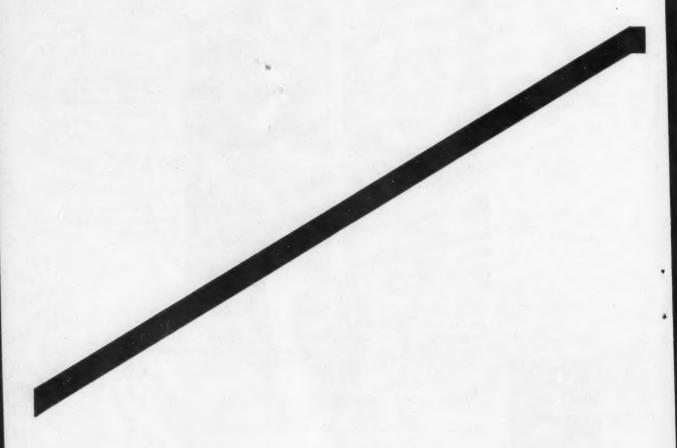
HYDRASHIFT Lathes/CINCINNATI Drilling Machines/SPIROPOINT Drill Sharpeners

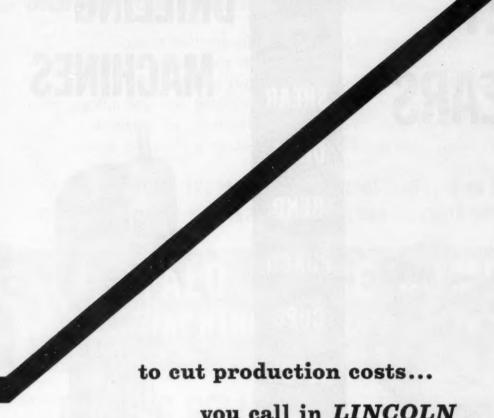
To identify a strange fish...



you call in an ICHTHYOLOGIST

(specialist in fish life)





you call in LINCOLN

(specialists in arc welding)

ECAUSE of high operating costs a Maryland barge builder had trouble meeting O competitive prices. The LINCOLN Field Engineer recommended a semiautomatic "Squirt" welder. On heavy plate it was four times faster and reduced overall costs due to reduced plate preparation and cleaning time.

As a matter of fact, right there is a good reason for doing business with LINCOLN. Cost reduction is a sort of religion at LINCOLN where production costs have dropped as much as 50% in the last 20 years. It's the result of LINCOLN'S world-famous cooperation between employees and management where everybody gets paid according to his own contribution to the company's goal-superior products and service to you at continually decreasing costs.

That's why we say it's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a "plus" at no charge.

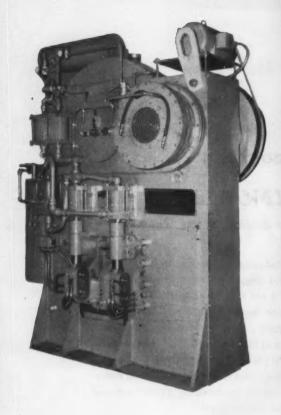
To learn how LINCOLN can be of service to you, write today

THE LINCOLN ELECTRIC COMPANY

Dept. 2210 · Cleveland 17, Ohio



## BILLET SHEARS



PRODUCTION CUTTING OF BILLETS — the "400" Billet Shear introduces advanced features. It will function at full capacity (within its rating) on any shearable material... Up to 4" square or 4½" round... Operates at speeds up to 60 strokes per minute! Makes clean, square cuts. May be automated for a potential of as many as 18,000 cuts in an 8-hour shift. Rigid alloy steel frame, electrical controls, air-operated automatic oiling system.

## SHEAR DRILL BEND **PUNCH** COPE NOTCH SLIT for **Production** or **Maintenance**

# DRILLING MACHINES



DRILLS "IMPOSSIBLE" JOBS—the matchless "RPMster" with instant fingertip speed control, all-geared power feed, nickel steel ball bearing back gears and full ball bearing alloy steel spindle. Available in 1", 1½" and 2" drill capacities. New hollow spindle permits use of advanced type bits in drilling exotic metals and other "impossible" jobs.

### **Sharpen Your Production Efficiency...**

Look at your obsolete, worn out equipment. Consider your loss in unit production, poor work quality. You can change this loss to a profit with modern *Buffalo* Machine Tools. Quality Built for years of extra production life, *Buffalo* Machine Tools are being used in every industry for production and plant maintenance. Look them over, there is probably a model that should be in your plant right now.

GOING TO THE MACHINE TOOL EXPOSITION . . . 1960 ?
SEE THESE BUFFALO MACHINE TOOLS IN ACTION . . . BOOTH 551

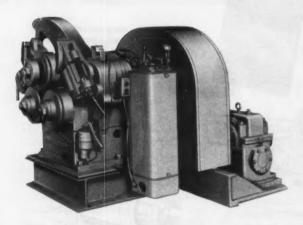


## BUFFALO FORGE COMPANY MACHINE TOOL DIVISION

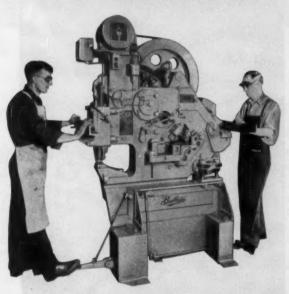
440 Broadway, Buffalo, N. Y. . Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

### **BENDING ROLLS**

## **IRON WORKERS**



COLD METAL BENDING WITHOUT DIES — Buffalo Bending Rolls handle angles, rounds, squares, tubes, pipes, flats, special shapes. Turn out commercially accurate circles, arcs and spirals at production speed. Setup is fast due to easily changed standard or special rolls and easy radius adjustment. Precision-built, heavy-duty machines, quality engineered throughout. New, compact speed-reducer drive means important savings in floor space.



SEVEN OPERATIONS—SAME MACHINE WITHOUT CHANGING TOOLS—the Buffalo Universal Iron Worker. A rugged, versatile "1-machine shop" that cuts, punches, shears, slits, notches and copes—saves valuable shop space, makes short work of your maintenance and production fabrication jobs.



## Yoder Rotary Slitters reduce inventory... speed production

To help meet the demands of tight production schedules, YODER Slitters reduce mill-width stock quickly and economically to desired widths. If your needs are as low as 100 tons per month, time and manpower savings alone will offset the cost of your YODER Slitter in a matter of months, while reducing basic inventories. Compactly designed, standard YODER Slitters are built to handle standard coil widths...completely engineered lines for special requirements.

YODER accessories, such as coil cars, swivel unloaders, scrap choppers, scrap disposers, plate levelers and coil boxes, make stock handling fast and easy.

YODER also makes a complete line of Cold Roll-Forming equipment and Pipe and Tube Mills. To profit from YODER'S years of engineering and service experience, contact your local YODER representative or send for the YODER Slitter Manual.

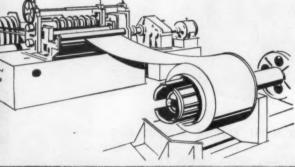
#### THE YODER COMPANY

5504 Walworth Avenue

Cleveland 1, Ohio



Investigate the many advantages of YODER-engineered Slitter Installations. Write today for this comprehensive, 80 page YODER Slitter Manual ...it's yours for the asking!

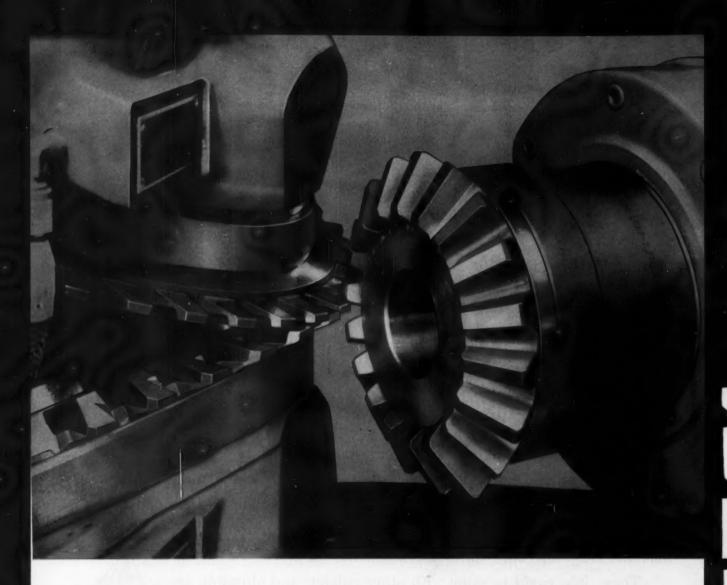


YODER
MANUFACTURING

ROTARY SLITTING LINES

PIPE AND TUBE MILLS (ferrous or non-ferrous)

COLD ROLL FORMING MACHINES



## How to complete gears up to 16" O.D. in one cut from the solid

The Gleason No. 114 Straight Bevel Coniflex® Generator cuts gears directly from the solid in diameters up to 16", up to  $2\frac{1}{2}$ " face width and  $2\frac{1}{2}$  diametral pitch.

With it you obtain much faster production rates—up to five times faster than with other methods. Still it retains a basic flexibility which permits quick changeovers from one job to another.

Excellent quality. Even with the speed of the No. 114 Coniflex Generator, quality remains excellent. It provides a smooth blend of root, fillet, and tooth flank—your assurance of strong, accurate teeth.

Coniflex gears give localized tooth

bearing, too, assuring practical assembly tolerances.

Simplified colculations. You can do all calculations with a slide rule. You can also control tooth bearing easily to suit various operating conditions or to set up interchangeability with existing gears.

For more details on the No. 114, write for bulletin.



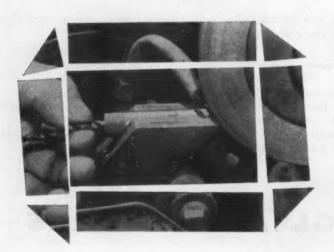


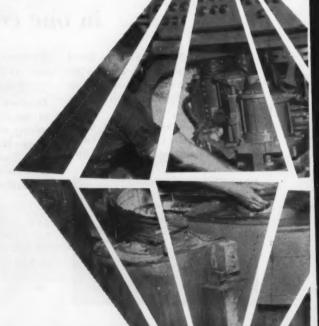


#### DIAMONDS AT WORK

Industrial diamonds are, first and foremost, *tools*. They're used in many ways to do many jobs. Diamonds keep hardest carbide tools sharp and efficient. Diamond wheels shave jet runways to perfect smoothness. Diamond tools speed up production of precision aluminum parts for automobiles. Diamonds machine close-tolerance ceramic components for electronic systems.

These jobs *could* be done with other cutting and abrading tools. But in every case, diamonds do them better. Not only better: *more economical* Council.







If that's not economy, what is?

If you cut, sharpen, or smooth in your business, you can probably use diamonds to advantage. Wide assortments are available in any quantity to your diamond wheel and tool maker. See him for more information.



INDUSTRIAL DISTRIBUTORS (SALES), LTD.

CUT PRACTICALLY

EVERYTHING...

ESPECIALLY YOUR

PRODUCTION COSTS

Industrial Distributors (Sales), Ltd., is the world distributor of natural industrial diamonds... the most efficient cutting, polishing and abrading substance known to man. Industrial Distributors sponsors the Diamond Research Laboratory. Its work is devoted exclusively to investigations on all phases of the diamond. The Laboratory stands ready to offer information and assistance to all users of industrial diamonds. Please address your inquiries to: The Diamond Research Laboratory, P.O. Box 104, Crown Mines, Johannesburg, Union of South Africa.

## RUGGED to full tool capacity!

...FOR LONG WORKING LIFE
TO ELIMINATE DOWNTIME & PRODUCTION LOSSES!



**THOMSON** 

# THRIFT MASTER DRILLHEADS









62

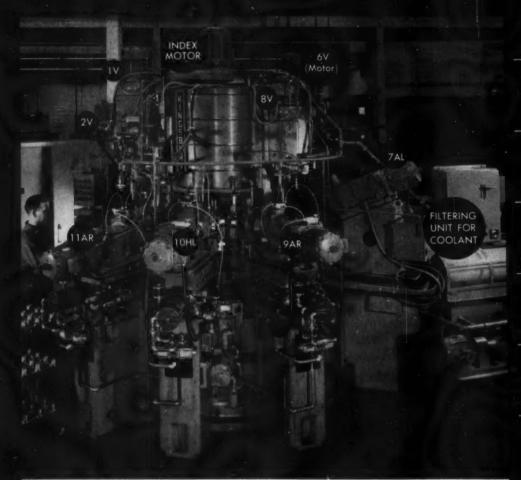
Tremendous economies from the use of multiple-spindle drill-heads are obvious. Use *THOMSON* THRIFTMASTER Drill-heads for optimum performance and profits. Ask NOW for our new catalog.



1022 NORTH PLUM ST. LANCASTER, PENNA. EXpress 2-2101

Also Makers of DORMAN AUTOMATIC REVERSE TAPPERS





# Kingsbury machine produces fine finish at high rate, performs variety of operations

### Easy change-over for work on similar part

In one chucking of the work twelve units on this Kingsbury perform all of the operations shown. With a 19-second time cycle for the operations and indexing, the gross production rate is 190 parts per hour.

#### SOME NOTEWORTHY FEATURES

**Mill face.** A motorized spindle produces a fine finish by running at high speed and then retracting from the work on the return stroke.

Mill oil pockets. Airdraulic slides position oscillating heads that feed the cutters sideways inside the hole.

**Drill angular oil holes.** Each unit is at an angle to the radial center line through its station. Two units are mounted on angular risers.

Five-step valve hole. Two units step gun

ream with high speeds and fine feeds using filtered coolant under pressure.

With a few changes this machine also operates on a similar part. A seven spindle auxiliary head can be mounted in two different positions to drill four holes in one part or three in the other.

#### WE BUILD SIMPLE MACHINES TOO

If you do drilling type operations in high production — simple or complex — we want to talk business. Our good basic design and accurate rugged construction pay off for you in minimum rejects

and downtime. Kingsbury Machine Tool Corp., Keene, New Hampshire.

KINGSBURY MULTI UNIT AUTOMATICS

### 12 OPERATIONS ON GOVERNOR BODY

1V Vertical

Step drill valve hole



2V Vertical

Mill face 7200 rpn fine finish

3H Horizontal

Rough bor



4AL Angular left, hidden

Drill angul

5H Horizontal

Drill flas

6V Vertical

Step gun ream part o

7 HR Horizontal

Drill angula

7 AL Angular left

Drill angu

8V Vertical

Step gun ream part of valve hole

9AR Angular right



10HL Horizontal left

Mill second oil pocket

11AR Angular right Mill third oil pocket



## This man is working

If you have never visited Michigan Tool's research and development laboratory, you really should. The birthplace of so many ideas—processes, equipment, tools and materials—industry today takes for granted, its activities have grown enormously with the broadening of Michigan Tool's services to industry.

The lab has two purposes.

The first, to find the answers to your immediate questions—in every phase of gear



Michigan Tool Company

MTC Research Engineer using an angular interferometer to check an indexing table. Accuracies to a millionth of an inch at 1 inch radius are possible with this equipment. Interferometer room temperature is controlled to ¼° F.



production, in automation, in generating of forms in hard materials, in producing prototype gearing, etc.

Its second job is to find the solution to some of the problems you will face tomorrow—to keep up the pioneering pace of engineering leadership that produced such innovations as gear shaving, Roto-Flo cold forming, Shear-Speed gear cutting, double-enveloping gearing, "Velvet-drop" feeders and other ideas for automation systems, Sine-Line optical checking, and many others.



Gear Production: The most complete line of equipment for gear production offered by any manufacturer.

Hobbers and Shapers for Job Lots
High Production Hobbers
Shear-Speed Gear Shapers
Roto-Flo Cold Forming
Shavers for gears of ½ " to 200"
Internal and External Form Grinders
Sine-Line Gear and Tool Checkers
Gear Chamfering Equipment
Abrasive Gear Finishers
Mitco Quality Gear Cutting Tools

Automation Equipment (Gear-O-Mation Division): Engineering and manufacture of simple and practical equipment for automating a plant, a line, or a machine. Preengineered units for orienting, storage, loading, unloading, assembling, conveying, escapements, positioning, elevating, deeding.

Form Grinding (Gear Grinding Machines Division): "Detroit" fully automatic form grinders for both external and internal contours—involute, cycloidal, spherical, straight sided.

Prototype Gearing (Enterprise Division):

Spur, helical, bevel gears and splines for prototypes and in developmental quantities. Also contour form grinding, internal and external.

## OTHER MICHIGAN TOOL DIVISIONS INCLUDE:

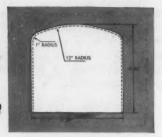
Cone-Drive Gears Division (double-enveloping worm gears, speed reducers, gear motors); Michigan-Lorenz Division (hobbers and shapers); Shear-Speed Chemical Products Division (coolants and cutting oils); Colonial Tool Co. of Canada Ltd. (cutting tools of all types).

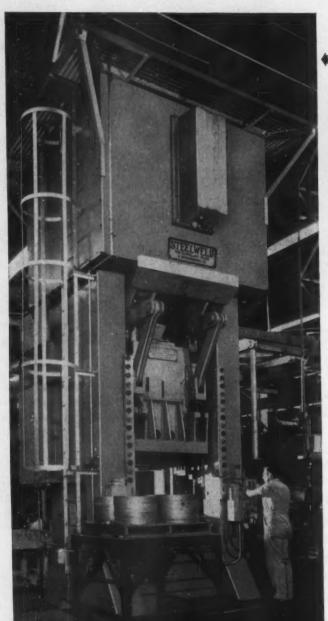
7171 E. McNICHOLS ROAD . DETROIT . TW 1-3111

Plants in: Detroit, Traverse City and Manistee, Mich. and Windsor, Ontario.

## DEEP-DRAWN SHELLS FORMED IN SINGLE DRAW ON STEELWELD SPEED-DRAW PRESS

Draw Is Greater than 50% REDUCTION from Blank Size





This shell is stamped in a single draw from a 22% inch diameter steel blank. Material is 0.1644" draw-type steel.

Model D1-400-48-54 Steelweld Double-Action Speed-Draw Press rated 400 tons capacity with 48 x 54 inch slide area.



Some of the great number of shells produced daily. All dimensions are held accurately to specifications and the stampings are smooth and uniform.

A new kind of press with unique, patented toggle-eccentric mechanism stamps shells for air-conditioning units in a single draw from 22¾" dia. blanks to dimensions shown in sketch.

The unusual operating principle of the Speed-Draw Press permits making extra long draws at higher speeds than shallow draws can be made on a standard cranktype press. The deep-draw feature frequently reduces the number of operations required to form a part and often permits operations that are not possible on a standard press. Because of these advantages, parts can normally be produced at a far greater speed on a Steelweld Speed-Draw Press.

Write for free catalog No. 2029

## STEELWELD SPEED-DRAW PRESSES

Steelweld Machinery Includes: Mechanical & Hydrautic Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

STEELWELD MACHINERY DIVISION . THE CLEVELAND CRANE & ENGINEERING CO. . 5403 E. 280 ST. . WICKLIFFE, OHIO

the quality of YOUR PRODUCT'S surface depends on the surface of the roll . . MACKLIN MCKLIN photograph courtesy Landis Tool Co. you can depend on MACKLIN .. ..... "Wheels of Profit"

For practical answers to your roll grinding problems depend on custom-engineered Macklin roll grinding wheels. Their controlled porosity and sharp grains give you top production and a surface free of traverse lines and scratches. They cut fast. Provide good finish without chatter . . . and are available in a complete range of grades and sizes.

You'll find it pays to consult your Macklin abrasive engineer. Regardless of the grinding problem, when you make him a part of your product team you can expect results like the performance records at the left.

> Get the complete story. Write for Roll Grinding Bulletin RG60 today.

#### HERE'S PROOF OF PERFORMANCE.

HOT MILL WORK ROLLS (Chilled Iron)

Roll size - 251/2" x 66" long

Comment - "Since this is a new plant and operators are limited in experience, this wheel has increased their production and produced a good finish of 15 to 20 Micro Inch. All operators are pleased with this wheel. It grinds 100 rolls in 95 hours."

36" x 4" x 20"-GC361 J15 B1268

COLD MILL TEMPER MILL ROLLS

(Forged Steel)

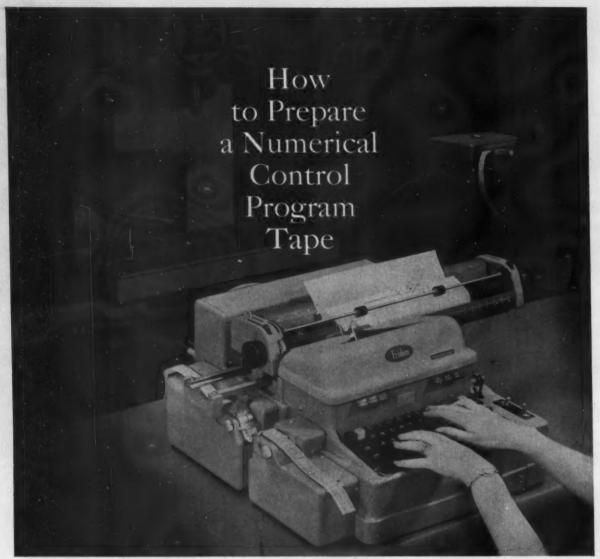
Roll Size - 201/2" x 48" long. Comment-"Macklin wheel ground 265 rolls and removed 2.109" of stock. Competitive wheel ground 156 rolls and removed 1.297" of stock. The Macklin wheel gave 62% more production than previous wheel used."

30" x 51/2" x 12"-A70 L11 B2



Ncompany Circle page 67 on card

Dept. 14., Jackson, Michigan



### (An Industrial Revolution In One Easy Lesson)

This is the Friden Flexowriter: a heavy-duty, automatic electric typewriter, with an integral tape punch and tape reader. There is no faster, easier or better device for coding paper tapes. Here's why:

- The keyboard is standard; any competent typist can master the other controls in less than an hour.
- The operator types a visual proof as she makes the tape; errors are caught and corrected immediately.
- 3) Automatic parity check guarantees against mis-coding.
- 4) Tapes can be double-checked (or quickly duplicated) by running them through the reader.

For all these reasons, the great majority of machine tool manufacturers either have standardized or are now standardizing on the Friden tape reader with Flexowriter input. Take it from the pioneers in numerical control: punched paper tape is the best input; and in punched paper tape, Friden is by far the leader.

In business, communications, graphic arts, and now in heavy industry, Friden source data systems build a new concept. We call it PRACTIMATION: automation so hand-in-hand with practicality there can be no other word for it.



FRIDEN, INC., SAN LEANDRO, CALIFORNIA - SALES, SERVICE AND INSTRUCTION THROUGHOUT THE U.S. AND THE WORLD

## TOGLAEWS



A new blade which provides an automatic average increase of 36% in blade life when milling such metals as cast iron, aluminum, magnesium or steel is now available for all Wesson Rigidcut series 5200, 5400 and 5500 milling cutters.

Assuming that .030 in. is removed per grind, a total of 17 regrinds is possible with the new design as compared with an average of 12 regrinds on the former blade. There is also less carbide left to be scrapped when the blade is "worn out."

The new blades (series 7888) are being made available by Wesson at no increase in cost and may be used, without change, in existing series 5200, 5400 and 5500 Rigidcut milling cutters.

All three series of cutters are available in cutting diameters ranging from 4 in. to 32 in.

Blades are available for either RH or LH cutters.

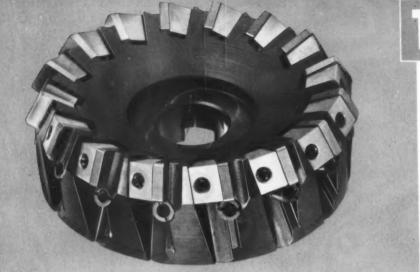
NEW #7888

17 GRINDS
(a) .030"

FORMER

12 GRINDS
UNUSED CARBIDE

More grinds and a minimum of carbide waste when "used up" characterize the new Wesson blade for Rigidcut milling cutters.



## Throwaway Insert Cutters Adjustable for First Time

Milling cutters for throwaway carbide inserts with each insert individually adjustable to tenths of a thousandth are now available for the first time. The new development permits the use of throwaway inserts with commercial tolerances without face runout, and allows cutters to be used for finishing as well as roughing, if desired.

This major breakthrough in the use of throwaway inserts for milling is made possible by an extremely simple device. The axial support for each insert is a cam shaped pin which is taper-locked in position into the

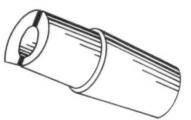
cutter body. To advance or retract the insert, a differential screw holding the pin in the cutter body is loosened. The pin is then turned the exact amount desired of insert advance, and the pin is again locked with the screw.

Total adjustment range is .030 in. for each insert, thus allowing for practically any combination of tolerance variations in a milling cutter assembly.

The milling cutter with the new adjustable pin is available as standard in a majority of lead angles and diameters ranging from 5 inches up.

For details, ask for Bulletin #358





To adjust a blade, the blade lock is loosened and the taper lock pin released by turning the screw within the taper lock pin. The pin with its uniform-rise cam seat is then rotated for the desired amount of advance, and pin and blade locks are tightened again.

FOR FURTHER INFORMATION, CIRCLE READERS' SERVICE CARD A-2

## TOCORDIA EUS

## Which do you need?



#### Bulletin MF-260

Complete Prices and Specifications

#### Bulletin T-160

For Throwaway and Slug Type Inserts

#### Bulletin B-1259

Micro-Adjustable and Fixed; Single and Multiple

#### Bulletin MF-360

End Mills, Counterbores, Lathe Centers, Core Drills, Reamers, Vises

#### Bulletin No. 358

Covering Throwaway and Rigidcut Milling Cutters

All literature requests should be on company letterhead



WESSON COMPANY, DEPT. AD

IN CANADA

WESSON CUTTING TOOLS, LTD.

93 Judge Road, Toronto 18, Ontario







# You can produce greater savings than you can buy

It is not how much you spend, but what you receive for your money that determines a bargain.

The economic truth of the above statement applies to all manufacturing and is especially true in grinding wheels.

There are cheaper grinding wheels than Norton wheels — and on the invoice they may look like a bargain. But if the wheels purchased fail to perform efficiently on the production line or incur production delays because of poor quality or misapplication — a higher cost of production is the price actually paid.

In brief, the true measure of grinding wheel value is not how much you paid for it — but how much you get from it. Here is what you can get from Norton —

Norton Company gives you the most advanced research engineering and manufacturing facilities in the entire abrasive field — and you get this great scope of detailed knowledge on a personal basis — your Norton Man.

Your Norton Man starts his career by spending a minimum of one year in a carefully planned training course in the Norton plant and a comparable period of training in the field. The Norton Man has an average of 15 years' abrasive experience in addition to the specialized training. He is the most knowledgeable man in abrasives that you can consult. He is your consulting abrasive engineer.

He will make a free Abrasive Requirement Study for you. This study lists the correct specifications for each abrasive job in your plant to assure you lowest cost-per-piece produced. He is also available for complete field testing on specific problems.

For example, your Norton Man can increase production by pointing out ways to better wheel usage and fewer wheel changes. He has the widest selection of grinding wheels in the industry to help him select the perfect wheel for new product grinding operations and improving your current grinding jobs — both at the lowest cost.

Norton economy pays off in lower cost-per-piece produced. Call your Norton Man. NORTON COMPANY, General Offices, Worcester 6, Mass. Plants and distributors around the world.

W-1973



75 years of ... Making better products...to make your products better



#### Another job you can do better

#### with versatile -Verson - Press Brakes

Properly used and properly tooled, the press brake can answer a wide range of production requirements efficiently and economically.

As an example, the 90 ton Verson Press Brake illustrated above performs complex piercing operations on fluorescent lighting fixture housings for Lighting Products, Inc., Highland Park, Illinois. The tool-up shown simultaneously pierces a number of holes of various sizes and shapes, completing all piercing operations on the 4', 20 gauge housing in a single stroke and a single handling.

When you are examining your production requirements, don't overlook the economy and versatility of Verson Press Brakes. Check the line-up at the right and write for a catalog.

#### THE - Verson PRESS BRAKE LINE-UP

MAJOR SERIES for the biggest and most demanding jobs...the ultimate in mechanical press brake design.

300 SERIES—90 tons capacity, bed and ram lengths up to 168".

INTERMEDIATE SERIES—65 tons capacity, bed and ram lengths to 144".

JUNIOR SERIES—50 tons capacity, bed and ram lengths to 96".

THRIFT-LINE MODELS—four sizes with capacities from 15 tons to 60 tons.

HYDRAULIC SERIES—capacities from 150 tons up.

Originators and pioneers of allsteel stamping press construction

#### VERSON ALLSTEEL PRESS CO.

<u>Verson</u>

9309 S. Kenwood Avenue, Chicago 19, Illinois • 8300 S. Central Expressway, Dallas, Texas

MANUFACTURERS OF MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES

TRANSMAT PRESSES • IMPACT MACHINING PRESSES • TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES • HYDRAULIC SHEARS



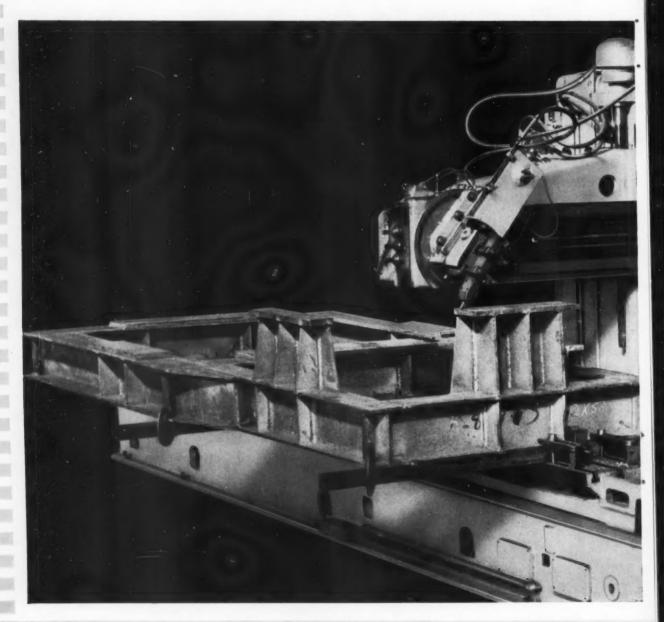
#### 338 YEARS OF MACHINE TOOL BUILDING EXPERIENCE

The individual trade marks of our companies, like the symbol of the machine tool exposition, represent 338 years of building machine tools and equipment to further production efficiency. You are cordially invited to see some of this industrial equipment in action in the booths listed above.

**Rockford Insert Group** 

Keep gathering metal-working production ideas...be well informed when you replace machinery.....

# Nothing does the job like a...





Machinery, June, 1950

# HYDRAULIC

## **PLANER**

MACHINES GENERATOR-BASE WELDMENT WITH LESS HANDLING AND SET-UP, IN ONE-THIRD NORMAL PRODUCTION TIME



Dimensions Weldment ..... 8'7" wide .....15'3" long

Weight Workpiece ......5400 lbs.

Operation:

Planing top-side pads, highest pad 301/2" from base of work.

Set-Up Time .....1st set-up, 11/4 hrs., .....2nd set-up, 11/2 hrs., includes surface indication for continuation of cut.

#### Nothing performs like hydraulic power:

- Infinitely adjustable feeds and speeds;
- Smooth, uniform cutting pressures for finer finish;
- Maximum metal removal per H.P. expended;
- Low Costs for machining, cutting tools and maintenance.

ROCKFORD MACHINE TOOL CO.

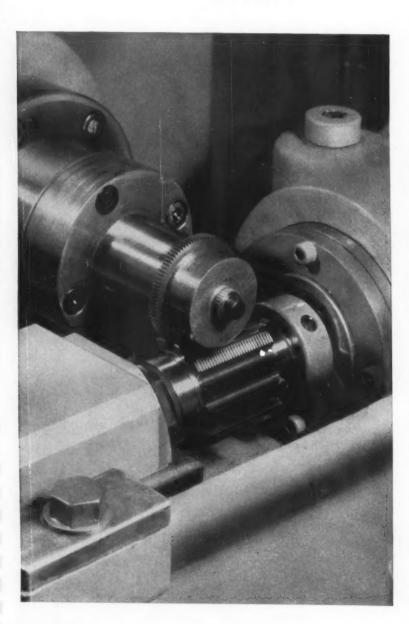
2500 KISHWAUKEE STREET . ROCKFORD, ILLINOIS

Pioneers In The Use of Hydraulic Power for Reciprocating Machine Tools



#### New method of producing

## **AGMA** Precision



#### Selection and segregation no longer necessary to insure precision-matched spur gear sets

Selection and segregation—the process of producing more gears than you need in order to select a few that are within Precision Class 2 or Class 3 tolerances—is no longer necessary. And, these jobs at PIC Design Corporation, East Rockaway, L.I., New York, prove it.

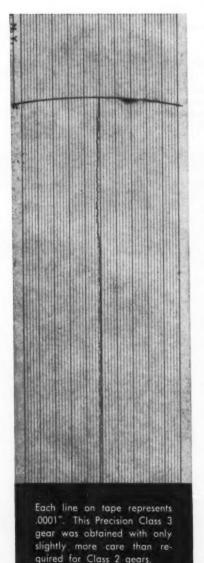
In pioneering "Ultracision" accuracy for the missiles industry, Barber-Colman Company developed extensive machining and testing techniques now embodied in a new, low-cost hobbing machine—the No. 2½-4. For mass production of easily machinable parts which do not require such a high degree of accuracy, a high-speed version of this machine is available with a maximum hob speed of 2400 rpm.

#### Completely new hobbing machine

New concepts have been introduced into the Barber-Colman No. 21/2-4 to bring you exceptional accuracy at a nominal cost. The No. 21/2-4 is guaranteed to index accurately within 20 seconds of arc. This means that nonadjacent spacing error on a 2" dia. gear would be only .0001" due solely to the indexing error of the machine. When rigid tooling . . . accurate blanks . . . care in mounting the hob and work . . . Class AA hobs ... and accurate hob-sharpening methods are used, it should be possible to hob AGMA Precision Class 2 and Class 3 gears without selection and segregation. Scrap and inspection time are reduced. And, in many



## Class 3 Gears



cases, deeper savings can result from the elimination of finishing operations.

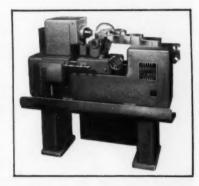
The accompanying PIC "true blue" gear tape shows the inspection record of a Precision Class 3 gear. On the production run, all gears had a total composite error of less than .0004". The gears have 96 teeth of 64 DP. The tape is made on a variable center-distance checking machine with a motor-driven master gear which rolls under preset pressure with the cut gear. After the work spindle adapter and the hob were trued within .0001", no further adjustments were necessary for hobbing gears of this accuracy.

The No.  $2\frac{1}{2}$ -4 accommodates 3" dia. hobs, permitting maximum number of flutes for cutting accurate, smooth tooth profiles. Maximum work diameter is  $2\frac{1}{2}$ " and length of cut is  $2\frac{1}{4}$ " — for steel gears as coarse as 30 pitch or brass up to 20 pitch.

#### PIC pursues accuracy in every corner of production

As you examine the results being achieved with the No. 2½-4 by PIC Design Corporation, you will see that in their pursuit of predictability and precision, no stone is left unturned.

Bores of Precision Class 2 and 3 gear blanks are machined to +.0002", -.0000" for size and roundness. Before turning, blanks are mounted on arbors the same size as the bores, with a .0002" taper. They are inspected for face wobble and must run true within .0002" per inch of diameter before the OD's are turned to a concentricity tolerance of .0001". This operation is checked at two points, 180 deg. apart.



In hobbing, the arbors are held in a floating adapter which permits fine adjustment to desired concentricity. PIC uses only Barber-Colman Class A or AA hobs, trued on the machine to less than .0001" runout.

#### Evaluate your gear processing and costs

If you have the problem of producing precision fine-pitch gears at a profit or want to improve your product by increasing gear accuracy, a Barber-Colman process analyst will help you evaluate methods, tooling, and cost improvements. Phone your B-C representative or the factory — WO 8-6833.

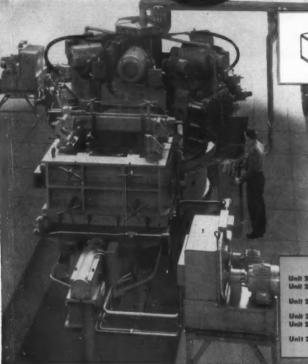
Barber-Colman Company



62 Loomis Street, Rockford, Illinois



# STANDARD













A Left-Hand Steel Case

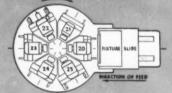
#### MACHINE No.

Standard Barnes "Versa-Matic" with 6-Station Rotary Table and Shuttle-Type Work Holding Fixture. Drills, reams, chamfers, and taps workpieces A, B, C, D, and E.

Gross Production (100% efficiency):

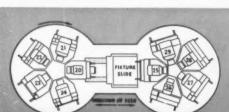
Cover Parts......9.50 per hr.

#### HEAD OPERATIONS



Standard Barnes "Versa-Matic" with Two Five-Station Rotary Tables and Shuttle-Type Work Holding Fixture. Drills, chamfers, reams, and counterbores different surfaces of same workpieces A, D, and E processed on Machine No. 1.

Approx. Loading Time per piece......3.00 min. Approx. Unloading Time per piece......2.00 min. Gross Production (100% efficiency)......2.90 per hr.



#### MACHINE No.



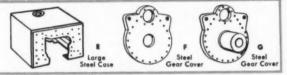
#### HEAD OPERATIONS



Machinery, May, 1960

MACHINES DESIGNED TO MEET YOUR HEEDS ROCKFORD, ILLINOIS, U.S.A.

# **NOW OFFER 3-WAY SAVINGS** FOR SMALL LOT MACHINING



#### Versa-Matic Design Assures Greater Efficiency on Low Production, Conserves **Capital Expense and Floor Space**

These new W. F. & John Barnes production machines, termed "Versa-Matics," illustrate three basic applications incorporating a new, exclusive principle in machine tool engineering which now makes possible substantial savings in handling a broad range of low production work. They are designed with standard indexing tables mounting multiple-spindle heads, and

Multiple Spindle Drilling . Boring .

are equipped with quick locating fixtures and shuttletype feed units that move the work to the tools. Electrical contact devices for each station are mounted overhead, and are the self-cleaning type. Contacts are fully interlocked and enclosed when in operation, with remaining contacts de-energized when out of operation. The versatility of these new machines with capacity for handling more than one workpiece, offer three-way savings. For example, for a road equipment manufacturer, machines illustrated provided up to 80% savings in floor space over any other processing method, and reduced equipment cost up to 50%. Handling many operations simultaneously, achieved high efficiency with less work handling. Now, for larger and smaller work, the new Barnes "Versa-Matics" are available in a range of standard sizes to serve your specific production requirement.





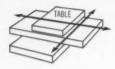
Automatic Progress-Thru Transfer-Type Machines

Gear Covers

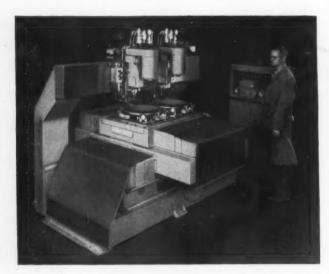
2.00 min.

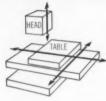
1.00 min.





1 This two-axis Sundstrand Jigmatic positioning table placed under existing machines, such as radial drills, eliminates jigs and fixtures, provides positioning accuracies to ±.001", greatly increases productivity. Table working surface is 20" x 30".





2 A moderately priced machine with two-axis positioning of work is provided by mounting one or more vertical heads on a simple frame above a Sundstrand numerically controlled Jigmatic table.

# "Engineered Production" concept applied to numerical control

. . . a system of machines to best meet the economic requirements of your production

There is no more reason to adapt your production to a particular type of numerically controlled machine than there is to adapt it to conventionally controlled machines. New Sundstrand machines with numerical point control have been developed to meet the Sundstrand "Engineered Production" concept — which evaluates your job requirements from the standpoint of methods and economics and then provides the machine that best fits these requirements.

Some of the machines illustrated are completely new types. Others are familiar Sundstrand machines with necessary design modifications to take the fullest advantage of numerical control. Any one of them is ready to fit right into your production line — to replace one or more machines now performing the same operation, or to combine several operations now performed on different machines.

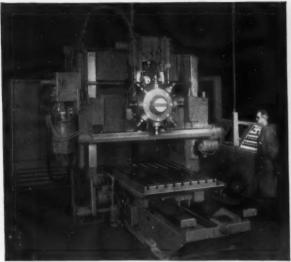
Other new Sundstrand numerically controlled machines now being built will extend the system to encompass a far greater range of requirements. Watch for their announcement — and be sure to see Sundstrand numerically controlled equipment at the Machine Tool Exposition, space No. 1014.

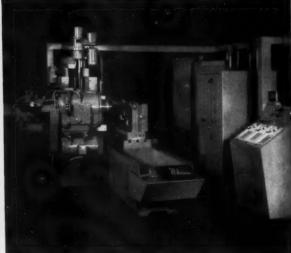


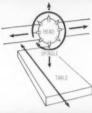
#### SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS . DIVISION OF SUNDSTRAND CORPORATION

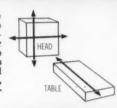






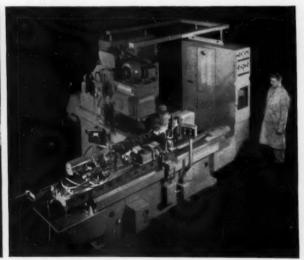


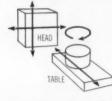
3 This new turret-type machine with a 40" x 60" table, provides the necessary range for precision machining of workpieces too large for the standard Jigmatic table. The head travels on a crossrail which is adequately supported at each end by a vertical column. All motions, including turret rotation, are numerically controlled.



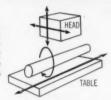
4 This three-axis machine with quick tool change handles a wide range of boring, drilling, reaming, tapping, milling, and related operations. The basic machine is built up of proven Sundstrand Rigidmil components, modified for numerical control. Table size and table and column travel can be furnished to suit job requirements.







5 This three-axis machine is equipped with a numerically controlled index fixture which presents all four sides of the workpiece to the cutting tools. Otherwise, it is identical to the machine described in paragraph 4 above.



6 This machine typifies the Sundstrand "Engineered Production" approach to machining. Designed to mill locating spots on six different crankshafts, the basic components are standard. The spindle and workpiece are numerically positioned.





















## Up to 21/2 times more production ... grinding springs on traveling-head machine

These large heavy springs, just like bed castings, long rails, and steel plates, can be mighty awkward to machine-costly if load and unload time ties up valuable machining capacity.

Not long ago, lack of rigidity and accuracy in a disc grinder posed a problem for Union Spring and Manufacturing Company, New Kensington, Pa.-one that was solved decisively by this Mattison UK traveling head face grinder. The new machine not only increased accuracy, it hiked production 21/2 times on some jobs, adding much-needed extra capacity.

With duplex loading stations on a stationary table, nonproductive machine time is virtually eliminated. While the wheel grinds at one station, work is loaded on the opposite side. Even while producing at a faster pace, the operator can load fixtures and grind springs to closer squareness tolerances than before. All functions of the machine are controlled from a central pushbutton panel.

#### Grinding production more than doubles

Grinding rates for one size of spring jumped from 10 to 20 per hour, and in another size from 2.38 to 6 springs per hour. In still a third size, production zoomed from 3 springs per hour to 734 per hour. Up to 21/2 times more production on the traveling head grinder!

#### Automatic cycling, uninterrupted production cut grinding costs

Here's how Union avoids the common and costly error of using precision machine tools as setup tables. With the wheel cutting at one station, the operator loads the opposite work fixture. Springs are placed against a fixed stop. A pushbutton actuates the rigid, air-powered holding fixture which clamps springs securely in position. Another pushbutton starts the automatic grinding cycle. The grinding wheel carriage reciprocates under hydraulic power on Vways of the massive Meehanite bed, quickly and accurately facing the spring. When the grind is completed on one part, the wheel-



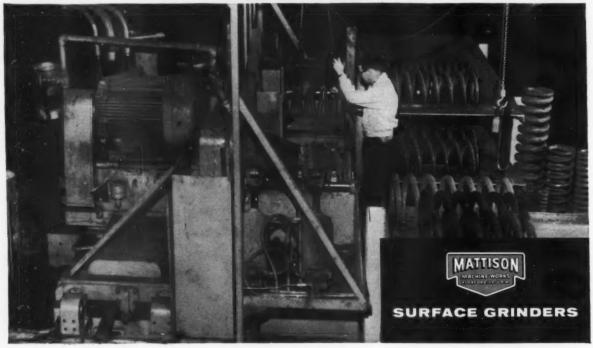
head indexes to the opposite station and grinds the first end of the next spring. Meanwhile, the opposite end of the first spring is positioned for grinding. The operator just releases the holding fixture, flops the spring, and pushes the start button.

#### Machine adjusts automatically for wear

Important to Union's program for increasing both productivity and accuracy-and a potential moneysaver for you, too—is automatic wheel adjustment. The Mattison grinding head can be fed automatically or manually in steps of .0005" to .003" to compensate for wheel wear and to control accuracy. The heavy, stationary table provides rigid support necessary for highpowered surface grinding of large partsreduces floor space requirements to little more than half that required by a traveling table machine of the same capacity.

Ask your Mattison dealer to show you additional features of the UK traveling wheel grinder, or contact the factory for a demonstration. Either way, it will be well worth your time to review this profitable method of face grinding.

MATTISON MACHINE WORKS Rockford, Illinois Phone WOodland 2-5521







## it took 35 seconds and 52 years to process this Diesel engine block

And 52 years? Yes, that's how long Greenlee has been building automatic transfer machines. In these years we have helped solve hundreds of widely diversified problems in automatic production. This experience has won exceptionally wide recognition in the automotive industry. That's why much of our business is repeat business from satisfied customers. If you haven't yet worked with us, now is the time to call. We stay on the job all the way . . . from the time of initial planning until the machine is operating at full efficiency.

1910 MASON AVE.

GREENLEE BROS. & CO.

ROCKFORD, ILLINOIS

GREENLEE

- Transfer-Type Processing Machines
- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Die Casting Machines
- Trim Presses
- Woodworking Machines and Tools
- Hydraulic and Hand Tools

Machinery, June, 1960

Time?



# THE MOST COMPREHENSIVE, UP-TO-DATE METALWORKING AND DESIGN HANDBOOK YOU CAN OWN!

#### ENLARGED

192 pages added in the 16th Edition

#### EXTENSIVELY REVISED

over 500 completely new pages of reference information and data

Whether you are a supervisor, foreman, inspector, toolmaker, machinist, student, or apprentice, you need an accurate, easy-to-use, up-to-date source of specific metalworking information.

Whether your interest is engineering, design, or production, you should have the latest facts, formulas and dimensional data available for ready reference.

Whatever your job, the new 16th Edition of MACHINERY'S HANDBOOK is a necessity. A reliable working handbook that will answer your questions, provide ready solutions to your work problems, give you information you need — when you need it.

Wherever metal products are designed and built, wherever metalworking operations are performed, MACHINERY'S HANDBOOK is the indispensable working reference. For more than 45 years it has been read and referred to on the job in thousands of drafting rooms, machine shops and manufacturing plants . . .

saving time, work and money for its users. No wonder over a million and a quarter copies have been sold! No wonder it has earned the reputation as "the bible of the mechanical industries"!

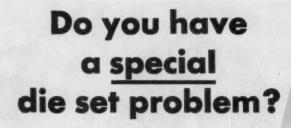
And now, in this greatly revised and enlarged edition, you get all the latest and best principles, practices, specifications, standards and other useful working data. The 16th Edition reflects the tremendous advances the metalworking industries have made; and it gives you the information you need to keep pace with that progress. The comprehensive cross-index and the convenient thumbindex will help you find any one of the subjects in seconds!

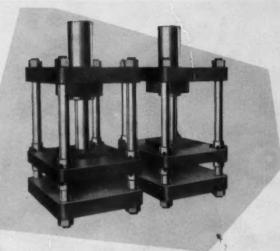
Dependable . . . accurate . . . authoritative . . . comprehensive, the new 16th Edition is the largest and best MACHINERY'S HANDBOOK ever published. Yet in physical size it is still a true HAND-book, compact and easy to use. It is the one book you will refer to again and again for the incomparable wealth of information it provides. Send for your copy today!

2104 Pages \$1100 Thumb Indexed

Bound in rugged, durable Sturdite. Stamped in genuine gold. Printed on tough, thin yet whiter paper for better reading contrast. Fully thumb indexed. Designed for heavy-duty reference on the job.

THE INDUSTRIAL PRESS 93 Worth Street, New York 13, N.Y.

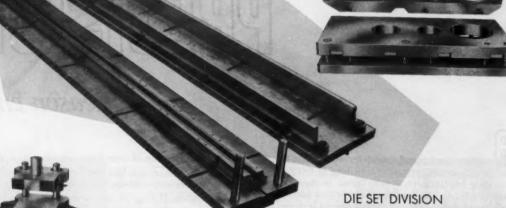




**Producto can help you solve it.** Special die sets can be large or small—weigh tons or a few pounds; they may be of steel plate, or castings; two-plate or multi-plate.

Often, they can be ordered directly from Producto's catalog. We regularly machine our "catalog specials" to meet your individual requirements. And, when you need a radically different, one-of-a-kind die set—call us. Our 35 years of die set manufacturing experience are yours for the asking.

Just call your nearby Producto distributor, or our manufacturing plants in Bridgeport or Detroit.



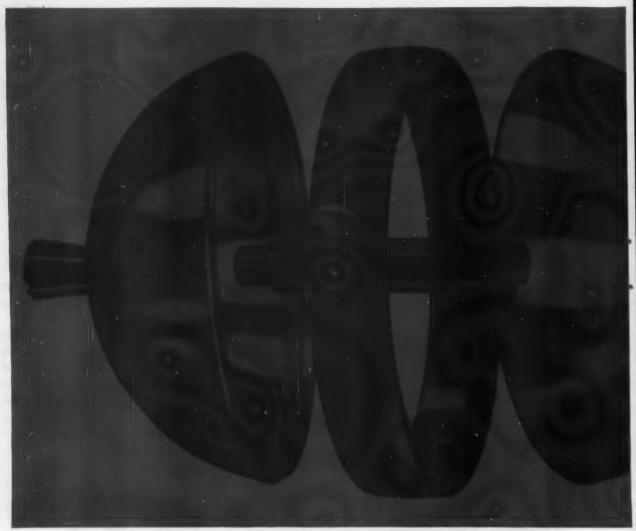
THE PRODUCTO MACHINE COMPANY

984 Housatonic Avenue, Bridgeport 1, Connecticut

PRODUCTO

MACHINERY, June, 1960

For more data circle this page number on card at back of book



# PREGISION:

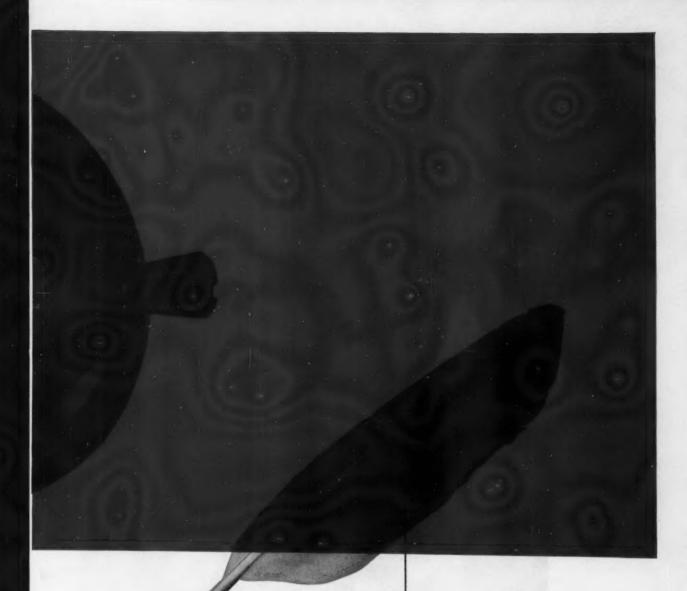
#### Reason enough

Deryllium specialists, Leemath Incorporated of Long Island, create delicate and precise mechanisms in this high strength but toxic and abrasive wonder metal. In their temperature-controlled shop, this feather-light gyro float assembly (shown actual size, right) was turned on a special high-precision Le-Blond Dual-Drive Lathe. Spherocity had to be concentric with the two major axes within .0005" total indicated runout of 1.8750" / (In order to hold the assembly that close, component tolerances had to be even tighter!)

To perform such touchy work, Leemath ordered their Le-Blond 15" Dual-Drive to ultra-high precision standards. For this lathe Timken furnished specially-made bearings with onethird the runout of their finest precision class. With it came the standard features that give LeBlond its reputation for long-lived precision—combination gear-belt drive headstock with 16 speeds, 31 to 2400 rpm; compensating vee bed way construction with hardened steel shears; thrust-lock tailstock; and many more.

People buy lathes for many reasons. But when, like Leemath, they must have precision they can depend upon, that is reason enough to buy LeBlond.

If you would like to have the full story of LeBlond's Dual-Drive, ask your distributor or write for Bulletin 6A.



to buy LeBlond



LEBLOND of Cincinnati

MACHINERY, June, 1960

For more data circle this page number on card at back of book

See Fosmatic Depth Control in action at the Machine Tool Exposition in Chicago, September 6-16.



# PRECISIO



# Numerical Control in three directions



DEPTH CONTROL developed by Fosdick, adds the ultimate third dimension to precision boring. Use random length tools for boring to depth under complete numerical control. Combine rapid depth control with horizontal positioning, preselected spindle speeds and feeds, coolant on-off, tool selection, even automatic tool changing, all by Fosmatic Numerical Control.

Tape or dial any depth. Absolutely no stops to preset.

Fosmatic Numerical Control easily fits into a cabinet small as your home refrigerator. The Fosdick system is electromechanical. Its electrical components are simple, easily maintained.

Always, with or without numerical control, you depend on a Fosmatic for precision within 0.0001".

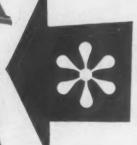
Keep precision machining control in the front office. Relieve the operator of his "fear of error." Investigate—and invest in lower costs with Fosmatic precision, now. Write for Catalog PB-A.

BORING

-OSDICK

THE FOSDICK MACHINE TOOL COMPANY CINCINNATI 23, OHIO





... for better "deep-slotting" operations!

STANDARD'S



Stagger-tooth type cutter is designed with alternate right and left spiral teeth.

This design feature assures a balanced cut, reduces chatter, provides extra chip space, and results in smooth machining on rough and deepslot milling operations.

STANDARD makes a quality cutter to meet your job requirements:-

- . SIDE MILLING CUTTERS
- PLAIN MILLING CUTTERS
   Heavy Duty . . . Regular
- . FORM RELIEVED CUTTERS
- . HELICAL PLAIN CUTTERS
- . KEY SEAT CUTTERS
  - . SLITTING SAWS
  - . SCREW SLOTTING CUTTERS

"Standardize" on STANDARD CUTTERS, . . . they're designed to "smooth-out"

rough milling operations!



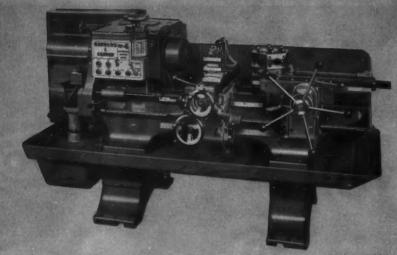
Take advantage of STANDARD'S experience and know-how in metallurgy and engineering for your metal cutting problems.

Call the STANDARD Distributor in your area.

3950 CHESTER AVENUE

CLEVELAND 14, OHIO

BRANCH WAREHOUSES IN: NEW YORK - DETROIT - CHICAGO - DALLAS - LOS ANGELES - SAN FRANCISCO



RAM TYPE T	RAM TYPE TURRET LATHES						
Size	Bar Capacity	Swing Over Bed					
No. 1 Geared Electric	5/8" or 13/16"	11-1/2"					
No. 2 Geared Electric	1" or 1-1/4"	13-1/2"					
No. 3 Universal	1-1/2" or 2"	15-1/2"					
No. 4 Universal	2" or 2-1/2"	18-1/4"					
No. 7 Universal	2-1/2", 3" or 4-1/2"	21-1/2"					
SADDLE TYPE	SADDLE TYPE TURRET LATHE						
No. 21 Universal	2-1/2", 3" or 4-1/2"	21-1/4"					

#### **BARDONS & OLIVER**

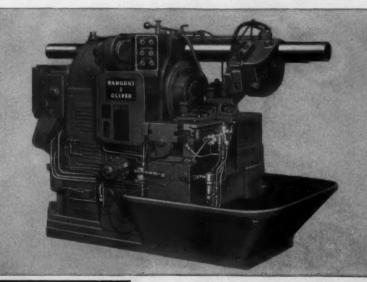
#### Turret Lathes . . . .

Each of the six Turret Lathes listed is a completely different machine, designed specifically for one range of work. All units on each machine, including the cross slide and carriage, and the turret slide and saddle, are "sized" for a particular work range. Thus adequate strength and rigidity is provided, maximum productive capacity is offered, and at the same time minimum operator effort is required. A complete line of tooling and attachments is available for each size of machine.

#### **Cutting-Off Lathes**

The Cutting-Off Lathes are designed to chamfer, form and cut off pipe, tubing, or bar stock with maximum efficiency. The number of pieces produced per hour often equals or exceeds that of much more expensive and complicated multiple spindle machines. Automatic loading tables, chamfer attachments, forming attachments, and automatic unloading devices are available for all sizes of Cutting-Off Lathes. These lathes are built as fully automatic, semi-automatic or hand operated.

CUTTING-OF	CUTTING-OFF LATHES				
Size	Capacity				
No. 32	2"				
No. 33 and 34	3", 4" and 4-1/2"				
No. 35 and 36	5-1/2" and 6-5/8"				
No. 38 and 39	8-5/8" and 9-5/8"				
No. 312 and 314	12-3/4" and 14"				
No. 316	16"				



#### BARDONS & OLIVER

BARDONS & OLIVER, INC., 1133 WEST 9th ST., CLEVELAND 13, OHIO Manufacturers of Turret Lathes and Cutting-Off Lathes

FROM CREATIVE CRUCIBLE: HIGH SPEED STEELS THAT MAKE BETTER TOOLS POSSIBLE

UNGROUND CLASS "C" HOBS, made from Crucible's M2S, consistently meet runout tolerances as required.

#### **ACCURATE HOBS-**

WITHOUT GRINDING! Toolmakers hold hob tolerances to less than 0.001" without finish grinding—because of improved manufacturing skills and continually improved Rex® High Speed Steels.

Today's toolmakers are not only producing accurate unground hobs to closer tolerances — they're also making them stronger, longer-lasting and with fewer grinding stresses.

What is behind this development? It's the skill of the toolmakers — combined with continuing Crucible developments that improve the quality of Rex High Speed Steels. Crucible tool steel metallurgists, working closely with producers of fine precision tools, are able to devise mill manufacturing practices to provide steels ideally suited to specific applications.

At Crucible, Rex High Speed Steels have always been produced under the close personal supervision of the most experienced men in the industry. Today, these men utilize the most advanced electronic instrumentation to assure the production of highest quality steels. For example, they use precision instruments to control the temperature of the molten metal, in the melting furnace, so each heat is produced under identical conditions. New techniques permit greatly improved deoxidation of the liquid steel. New ingot mold designs provide freedom from segregation when the steel solidifies. And all Rex High Speed Steel billets are inspected ultrasonically before they are rolled or forged.

As a result, Rex High Speed Steels continue to make the best hobs because they offer:

more uniform distribution of carbides throughout the section. This ensures minimum size change, greater predictability in heat treatment, greater hardenability and more uniform hardness in the heat-treated tool:

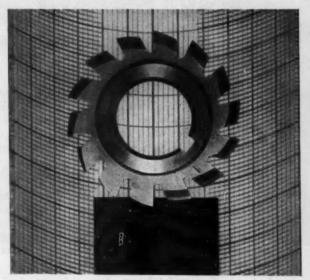
more uniform distribution of sulfides in the free-machining grades.
And this provides improved machinability and superior surface finish.

Single-Thread Gear-Hob Tolerances (in Ten Thousandths of an Inch)

DIAMETRAL PITCH											
	1 Thru 1,999	2 Timu 2,999	3 Thru 3.999	4 Thru 4.399	5 Thru 5.999	6 Thru 6.999	9 Thru 12,999	13 Thru 19,599	20 Thru 29.999	30 Thru 50.999	SI and Finer
BUNGUT											
Butside Bia, C	50	45	40	25	20	17	17	12	12	10	

Table: Metal Cutting Tool Handbook

FINAL PROOF OF A HOB'S ACCURACY. This lead variation chart, produced by a special electronic recorder, provides a check of every tooth in the hob. Checks are made "against perfection"—so, any deviation shows up on the chart. Photomicrograph shows tooth area's structure and the uniform distribution of carbides in Crucible Rex M2S. (Photo: 100X dia.)









#### CRUCIBLE

STEEL COMPANY OF AMERICA

Branch Offices and Warehouses: Atlanta • Baltimore • Boston • Buffalo • Caldwell, N. J Charlotte • Chicago • Cincinnati • Cleveland • Columbus • Dallas • Dayton • Denver • Detroit • Erie, Pa. • Grand Rapids • Houstor Indianapolis • Los Angeles • Miami • Milwaukee • Minneapolis • New Haven • New York • Phitadelphia • Pittsburgh • Portland, Ore Providence • Rockford • Salt Lake City • San Francisco • Seattle • Springfield, Mass. • St. Louis • E. Syracuse • Tampa • Toledo • Tuiss



This year marks the 20th in which Cosa Corporation has introduced, sold and serviced, the latest designs in imported precision machinery to help the metalworking industry increase productivity. You can choose from 20 lines of versatile metalworking equipment for production or toolroom use, from manually operated to fully automated tools, in capacities to fit your needs exactly.

Behind every machine, Cosa maintains a competent staff of machine tool experts, located throughout the country, to help you select the right machine for your requirements. An equally large staff of factorytrained service engineers installs and maintains your equipment for top performance throughout its production life. Most of these service engineers were formerly associated with the builders of the machines they service.

And, since Cosa maintains an adequate inventory of essential replacement parts, you can always depend on rapid, efficient service with manufacturer's approved parts. This is one of the reasons behind Cosa's well-earned reputation for dependability.

Cosa is an international organization, with offices strategically placed throughout the free world, serving industry with the largest selection of machine tools.

Write For Information on Your Requirements

#### CHECK COSA'S COMPLETE LIST FOR YOUR TOOLING NEEDS

Balancing Machines Bending and Forming Machines Boring Machines

Boring, Milling Horizontal Jig

Special Vertical

Chucking Machines Drilling Machines, Radial

Dynamometers
Engraving Machines
2 & 3 Dimensional Pantograph

Fatigue Testing Machines Flow Forming Machines Gear Checking and Testing

Machines Gear Hobbers Grinding Machines Cam & Contour

Centerless Cylindrical, Plain

Internal Jig Profile

Surface Tap, Tool & Cutter

Thread Universal

Jig Borers Lathes

Copy Turning Double End

Roll Turning Special Spinning

Tracer Turret, Vertical Milling Machines

Contour Die Sinking Horizontal Planers

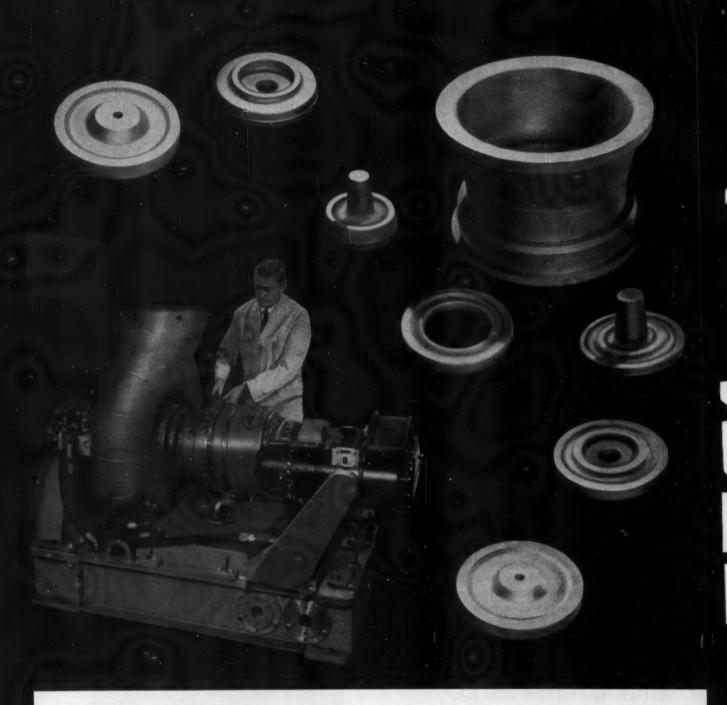
Profile Skin Special Universal

Vertical Nibbling Machines Planers, Open Side Rack Cutters

Roller Shears Screw Machines, Swiss, Coil-Fed Transfer Presses

Importers of Leading Precision Machine Tools Nationwide Sales and Service

COSA CORPORATION, 405 LEXINGTON AVENUE, NEW YORK 17, N.Y.



#### CAMERON FORGINGS IN THE SOLAR SATURN\* ENGINE

Solar Aircraft Company's 1,100 H.P. Saturn Industrial Gas Turbine Engine weighs about 1,000 pounds—its unusually efficient performance is setting new standards in new applications for the up and coming gas turbines. Increased reliability and versatility in gas turbines required something new in forging performance. That's why Solar called on Cameron for all the rotating forgings in the Saturn.

Both pure jet and turbo jet forged components from Cameron had already hit a new high in forming and metallurgical refinement. Properties at elevated temperatures consistently exceeded specifications, often as much as 20%. The Cameron forged Saturn engine components attest once more to the high quality and favorable properties which have become a specialty with us. Cameron perfected processes have no exact counterpart in forging history. Ten years of steady success have supplied us with a wealth of case histories and technical refinement. If you design, specify, or purchase ferrous forgings for demanding service (exotic metals, extreme temperature, etc.), in conventional or unusual shapes, from a few pounds to 13,000 pounds in weight—just write, call or come by.

\*A Registered Trademark of Solar Aircraft Company

Cameron IRON WORKS, INC.

SPECIAL PRODUCTS DIVISION
P. O. Box 1212, Houston 1, Texas

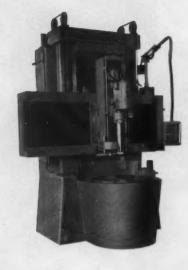
## Vertical Universal Grinders

Springfield vertical universal grinders are among the most versatile tools you can use for both production and toolroom work. Head is easily positioned to grind ODs, IDs, surfaces, offsets and undercuts in any combination, generally with one chucking. Work may be regular or irregular in shape, up to 48" high with up to 52" swing on standard machines. Weight of workpiece is no problem because gravity works for you in vertical grinding — helps achieve extreme micro-inch finish and concentricity.

A typical example of a Springfield's remarkable precision is its ability to grind taper valve plugs and seats with one angle setting of the head—and get 95% blue or better on a taper gage with surface finish smoother than 30 RMS.

For high production, sometimes involving automatic loading, cycling, size control and unloading, Springfield builds special vertical grinding machines. Most of these can be reset when part changes occur. Another area in which Springfield has pioneered is in vertical contour grinding machines that handle missile parts.

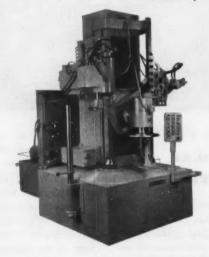
If you would like to know more about Springfield vertical grinders, please write for Bulletin 197-G.



model 3-TR 52" swing



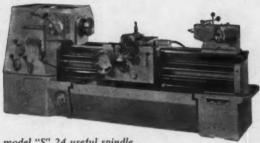
new developments coming!



vertical contour grinder

The Springfield Machine Tool Company Springfield, Ohio

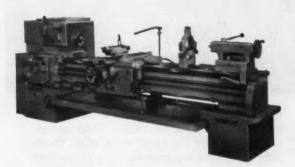




model "S" 24 useful spindle speeds, 66 feeds & threads heavy duty 16" medium duty 20"



new developments coming!



model 280 16 useful spindle speeds, 60 feeds & threads heavy duty 14", 16" medium duty 20"

> The Springfield Machine Tool Company Springfield, Ohio

# Engine & Toolroom Lathes

Springfield lathes have 10, 15 or 20 horsepower motors for heavy cuts, and have simple, practical features that keep the operator productive and keep the maintenance man away. Pressurized mist lubricates the headstock. Only four gears are in mesh for a given speed—the others run free. Clean, functional design and simplified controls promote pride of workmanship and minimum waste motion.

Ruggedness with precision has always been characteristic of Springfield lathes—because they are built to one standard of excellence. A Springfield engine lathe meets the accuracy standards set up for toolroom lathes—without any cost penalty.

Whenever you want maximum power and efficiency, and the cost designed out by designing simplicity in, consider a Springfield lathe. A full range of attachments is available—hydraulic contouring and reproducing, plain and universal relieving, taper, etc.

If you would like to know more about Springfield lathes, please write for Bulletins 190-G and 201-G.





because

Jagar

design uses more spindles in smaller space with minimum tooling and requires short change-over time

Four fixture assemblies, mountable on a common index table, have five stations each for drilling, reaming, and tapping left- and righthand cylinders at 400 pieces per hour. In all, 2800 holes are produced.



Zagar gearless design permits flexibilities in building machinery with results not obtainable elsewhere. By using many spindles and tooling more parts in one machine, fewer units, less space, and little change-over time are required.

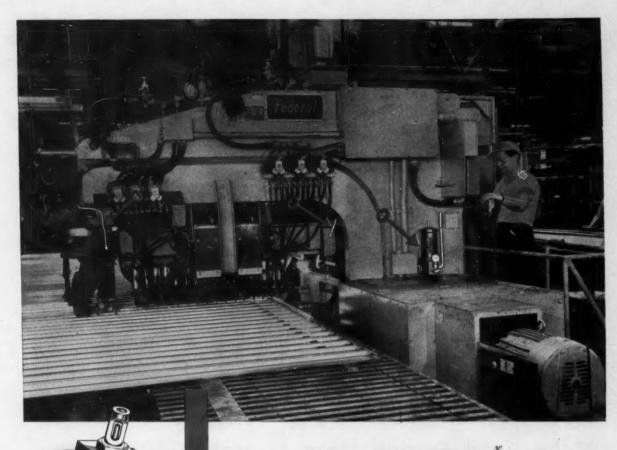
Gearless design allows close center hole production without changing spindle locations in heads. Varying hole patterns can be obtained without additional heads. Interchangeable fixtures on the same index table, therefore, compound the potential hole production -in one basic unit.

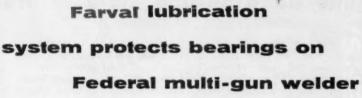
Find out how Zagar can program your entire drilling, reaming, and tapping job by sending us a part for an engineering study.

Ask for Manual M-6 for basic Zagar theory.

SE MORE SPINDLES TO DO MORE WORK

98





Resistance welders such as this multi-gun Federal, owe much of their effectiveness to their ability to adjust vertical movement of electrodes within exacting limits. Chosen to guard the essential bearings which give this Federal welder its precise control is a modern Farval lubrication system.

FARVAL—Studies in Centralized Lubrication No. 230

Across the country, Farval systems have dependably extended bearing life on all types of metalworking machinery... some for as long as 30 trouble-free years. That's because any Farval system—automatic or manually controlled—insures that measured amounts of lubricant are delivered to every desired point at predetermined intervals.

Let a Farval lubrication system help you extend vital bearing life.

Ask for revised Bulletin 26-T. Write...

Farval Division • Eaton Manufacturing Company 3276 East 80th Street • Cleveland 4, Ohio

KEYS TO ADEQUATE LUBRICATION

Wherever you see the sign of Farval

-familiar valve manifolds, dual

lubricant lines and central numbing

—familiar valve manifolds, dual lubricant lines and central pumping station—you know a machine is being properly lubricated.





#### New DoALL Heavy-Duty Contour Machines Make Hand Sawing More Accurate, 100% Faster

Now, for the first time, DoALL enables you to use H.S.S. bands on a fixed-table, manually fed band machine. You can speed your internal and external sawing, as well as machine filing and polishing . . . make 3-way savings. All these benefits are yours with the new, inexpensive type 2 DoALL Contour Machines:

FASTER CUTTING RATES. With Demon® high-speed steel saw bands you increase cutting rates 100%. These machines have all-welded, steel, box-frame construction to withstand the high tension needed on H.S.S. bands for high-speed cutting.

LARGER COOLANT SYSTEM. New large-volume coolant system with mist applicator gives high efficiency, prevents chip welding.

EXTRA-HEAVY-DUTY WELDER. You can weld H.S.S. saw bands up to ½ in. wide—right at the saw—with the new DoALL DBW-8 welder, now standard equipment on these machines. Its large capacity permits welding 1-in. carbon blades.

DoALL type 2 Contour Machines are built in four sizes with four throat depths of 16, 26, 36 and 60 in. Investigate these money-saving machines. Call your nearby DoALL store for demonstration or write for free bulletin.



The new DoALL type 2 Contour Machines are ideal for toolroom use. Built with sturdy, all-welded, box-frame construction, they are equipped with an efficient mist coolant system and a new heavy-duty welder.









SIMPLE · VERSATILE · UNIQUE

New SKINNER 3-way Solenoid Valves

### All Skinner Solenoid Valves are...

SIMPLE-

Only two moving parts in direct acting valves. Stainless steel internal parts resist corrosion. Soft synthetic inserts provide bubbletight sealing. Most types available in explosion-proof construction.

VERSATILE— Literally thousands of variations are possible mounting, flow control and porting . . . electrical options in coils, voltages and frequencies . . . types of media, operating temperatures, etc.

UNIQUE-

Skinner valve seat does not cut inserts, assures bubbletight sealing and long life. Skinner valve sleeve assembly is precision welded to provide over 5,000 PSI burst strength. Skinner standard valve designs are readily modified for custom applications. From first step in manufacturing to delivery, Skinner quality control and 100 per cent testing builds valves Skinner guarantees for long, trouble-free life.



A—Transparent view of normally closed valve with main orifice shown solid
B—Plunger and spring C—Sleeve D—Coll E—Yoke

#### **SKINNER** three-way solenoid valves solve your control system problems

Whatever your problem in controls . . . in machine tool automation, automatic clutching or braking. packaging, instrumentation, laundry equipment, air conditioning, or in any of thousands of applications involving air and hydraulic cylinders or pressurized mechanisms . . . Skinner has the answers.

Skinner design leadership and quality manufac-

ture of solenoid valves has been proved by universally successful use. And as control problems become more complex, Skinner keeps pace with new designs, new valves, and continued top quality production.

The new A series shown above, the new L series, the V5 and V10 series complete the line of Skinner 3-way solenoid valves. Your selection is unlimited.

	V5 Series	V10 Series	A Series	L Series
Orifice sizes	1/2" to 1/4"	3/2"	3/2", 3/6", 5/2"	36", 36", 36"
Pressure Ratings	Up to 200 PSI	1000 PSI	Up to 250 PSI	5 to 150 PSI
Types	Normally open, normally closed, directional control, multi-purpose	Normally open, normally closed, directional control, multi-purpose	Normally open, normally closed, directional control, multi-purpose	Normally open, normally closed, directional control
Construction	Stainless steel body Stainless steel internal parts	Stainless steel body Stainless steel internal parts	Zinc die-cast body Stainless steel internal parts	Forged naval brass body Stainless steel and brass internal parts
Body Pipe Connector	% and % NPT	% NPT	% NPTF	%", %", %" NPTF

When you specify solenoid valves, specify Skinner.

Skinner solenoid valves are distributed nationally.

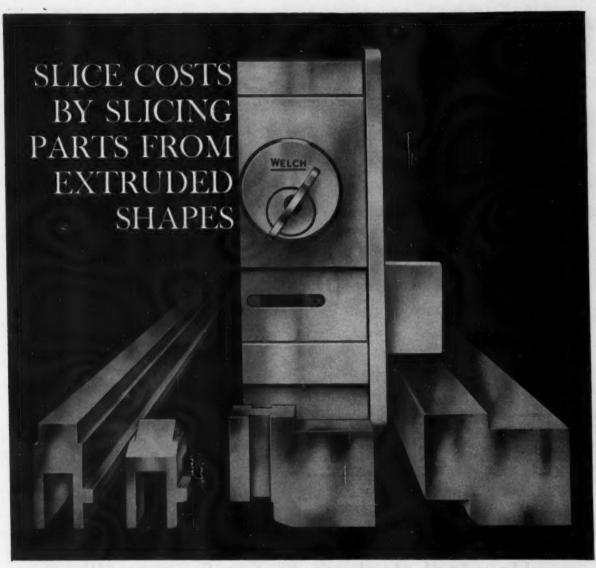
For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at the address below.



THE CREST OF QUALITY

SKINNER ELECTRIC VALVE DIVISION. THE SKINNER CHUCK COMPANY . NEW BRITAIN, CONNECTICUT

PRINTED IN U.S.A.



#### Fabricating parts from long lengths of "premachined" shapes reduces machining, scrap, and finishing

The lock components shown above are typical of some 20 different precision brass parts which Welch, Inc., Waukegan, Ill., makes for its broad line of locks and latches, from Anaconda extruded shapes.

Welch works closely with Anaconda specialists from early design stages. New lock mechanisms are built around parts which can be cut by a metal slitting saw from long lengths of extruded shapes with minimum subsequent machining and scrap. The use of bar stock is never considered when there is the slightest possibility of designing savings into a part by means of a brass extrusion.

Superior quality, too. Parts made from extruded shapes are characterized by their strong, homogeneous, wrought-metal structure. And the smooth, extruded surfaces reduce many finishing operations.

More and more manufacturers are cutting fabricating costs and maintaining quality by using these preformed or, in effect, "premachined" shapes. For imaginative and practical help in adapting extruded shapes to the economical production of intricate parts, call your Anaconda representative or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

Extruded Shapes • Special-Shape Tubes • Die-Pressed Forgings

### **ANACONDA®**

products made by The American Brass Company



# How tool steel users save 5 ways with precision ground flats of GRAPH-MO®

Now you can have all the advantages of high-quality graphitic tool steel in a new, convenient form. Specify Graph-Mo® in precision ground flats and save because:

- 1. GRAPH-MO OUTWEARS ordinary tool steels 3 to 1 because of free graphite particles and diamond hard carbides in its structure.
- SEMI-FINISHED precision ground flats save you time and money by eliminating some preliminary operations.
- 3. 30% EASIER MACHINING saves you still more when you specify Graph-Mo.
- 4. GRAPH-MO'S HEAT TREATING response is

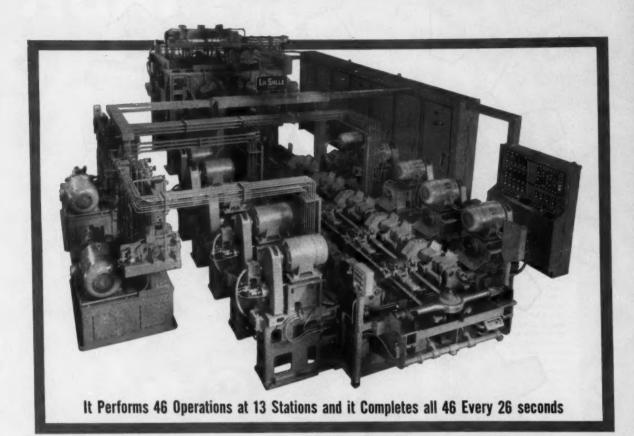
uniform, eliminates distortion in preparation.

SPECIAL PROTECTIVE WRAPPING assures top condition when you get ready to use your Graph-Mo precision ground flats.

There is only one Graph-Mo and the Timken Company makes it. Graph-Mo precision ground flats are available in 250 different sizes to give you maximum savings. Get your stock list from your local Timken steel distributor or write direct to: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

TIMKEN GRAPHITIC STEELS ARE AVAILABLE FROM STEEL SERVICE CENTERS IN 40 CITIES IN THE UNITED STATES AND CANADA

# LaSalle Rear Axle Housing Machine



#### Parts are Progressively Located and Clamped

Parts are clamped rigidly for roughing operations; lightly for finishing operations. Parts are easily removed at every station. Heads may be returned for tool change by holding "Head-Return" button depressed.

#### Standard LaSalle Sectional Modular Machine Construction

It provides complete accessibility to all sections and working tools, and will facilitate future part changes. All spindles are built to accept pre-set tools. Shuttle is the modified walking-beam type.

#### **Built to J.I.C. Standards**

Built to J.I.C. Electrical, Hydraulic, Pneumatic, and Lubrication Standards, throughout. Every unit motion, of the machine, is recorded by a mechanical latch-type relay, to guard against double-cycling, or, not cycling of the unit in the set-up.

#### It's the Newest and Finest Rear Axle Housing Machine

It was engineered and built for one of the leading automobile manufacturers, where high production is a must, for the assembly of high production models.

#### New Type Console Integrates Hydraulic and Electrical Controls

Hydraulic and Electrical systems are designated to follow the operations of the machine without using electrical or hydraulic diagrams. LoSalle Filters are used to filter all of the oil in the hydraulic system. O-Ring mountings are used for valves and fittings, on all hydraulic manifolds, to eliminate pipe-thread leakage.

#### **Central Coolant and Chip System**

There's a central coolant and chip system in this new machine. Moreover, individual regulators provide the coolant at every tool used in the machine.

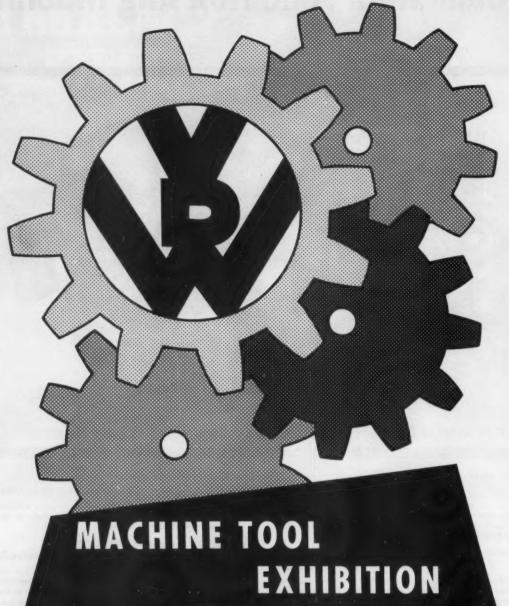
#### Another Excellent Example of Skillful Engineering

Write for Detailed Description of all 46 Operations

# La Salle machine tool, inc.

AUTOMATION ENGINEERS - SPECIAL MACHINE TOOLS

3840 EAST OUTER DRIVE . DETROIT 34. MICHIGAN



# **HANOVER** SEPTEMBER 11th TO 20th 1960

INFORMATION:

VEREIN DEUTSCHER WERKZEUGMASCHINENFABRIKEN (VDW)

FRANKFURT (MAIN), Am Hauptbahnhof 6

Telefon: 334570, Telegramm-Adresse: Modul, Telex: 41 2607



## Revere helps "fit the metal to the job"

AND A PUMP MANUFACTURER FABRICATES
SUPERIOR PARTS WITH GREATER EASE...INCREASES TOOL LIFE

An important part of the submersible pumps made by Tait Manufacturing Company is the brass diffuser casing you see above. This part had formerly been made of ferrous metal. While satisfactory as a pump part it was difficult to work and draw . . . at the same time tool life was short.

One of Revere's Technical Advisors was asked to study the problem. Revere Cartridge Brass Strip of a certain temper was recommended, samples submitted, and, after extensive tests, was approved. The customer has found that not only does the diffuser casing, made of Revere Brass, perform well in the pump, but it also has superior drawing properties, is more easily worked, and tool life has been substantially increased.

This meticulous attention to "fitting the metal to the job" also resulted in Tait Manufacturing Company's specifying Revere seamless leaded brass tubing for the upper body shell of its submersible pumps. Here the application called for extremely close straightness and roundness control which meant special attention to detail on the part of the Revere mills.

Why not put the extensive knowledge of Revere's T.A. Service to work for you? With the wide variety of metals at your disposal, perhaps Revere can help you select the one best suited for the job, with a resultant saving of money while improving product quality.



#### REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801 Executive Offices; 230 Park Avenue, New York 17, N. Y.

Mills: Rome, N. Y.; Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles, Riverside and Santa Ana, Calif.; New Bodford, Mass.; Brooklyn, N. Y.; Newport, Ark.; Fort Calbonn, Neb. Sales Offices in Principal Cities, Distributors Everywhere.



The illustration above shows a 2" HILL ACME Automatic Forging Machine with an induction heater producing \( \frac{6}{2} \)" and \( \frac{3}{2} \)" mine roof bolts, in lengths from 12" to 72", at the rate of 45 pieces per minute in sustained operation. Bars are loaded into the feeding rack where an index feed, chain driven, positions them for proper spacing through the induction furnace. As the bar ends are heated they are delivered, at the proper timing cycle, to the forging machine by a roller chain feed where they are gauged for length, picked up by fingers and passed progressively through the dies. Finished forgings are discharged from the back of the machine by means of a separately driven conveyor, arranged for both right and left hand discharge.

The design of this new HILL ACME AUTOMATIC forging unit does not limit the number of passes or the length of stock to be used in forging a variety of parts. Pieces longer than 36" are supported by a walking beam through the various passes.

HILL ACME AUTOMATIC forging machines are built in 11/4" to 5" capacities all of which can be automated. Your inquiry concerning high speed automatic forging equipment will receive prompt attention.



# The HILL ACME Company

Manufacturers of: "ACME" FORGING-TAPPING MACHINES-"CANTON" ALLIGATOR SHEARS-ROTARY SHEARS-BAR-BILLET SHEARS-"RILL"GRING-ING AND POLISHING MACHINES-HYDRAULIC SURFACE GRINDERS-"CLEVELAND" KNIVES-SHEAR BLADES-MATERIAL MANDLING FOUNDMENT

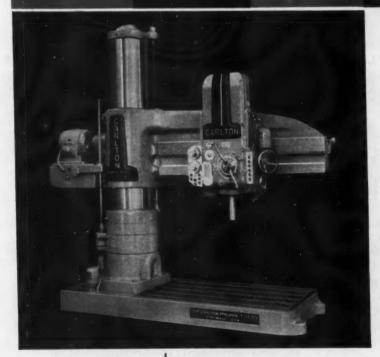


Model	Golumn diameters	Arm lengths	Speeds No. Range		Feeds No. Range		Motor recommended
			9	20 to 1	4	4 .006020	349.
1A	9"	3'-4' 3'-4'-5'	12	25 to 1	8	.006025	5-hp 'S or 7½-hp
3A	13° 15° 17°	4'-5' 4'-5'-6' 5'-6'-1'	36	100 to 1	u	.004125°	716, 10, 15, 20 or 25-hp
4A	19"	6'-7'-8'	36	100 to 1	18	.004125*	15 to 40-hp
SA	22° 26°	7' to 10' 8' to 12'	36	100 to 1	18	.004125*	26 to 40-hpt

°8, 11½, 14 and 18 threads per inch are standard, with various other combinations available. † Driving motor larger than 40 hp can be used if desired.

#### Carlton...the modern design radial drill

# OA 1A 3A 4A 5A



Only at Carlton can you take your choice of

- 5 different models of radial drills
- Column diameters from 9" to 26"; arm lengths from 3-ft. to 12-ft.
- 5 different types of speed-feed controls (3A, 4A and 5A models)

For the utmost in versatility, you can choose the Carlton Programming System that lets you pre-set speeds and feeds for a complete drilling sequence of 20 or more operations.

For production operations involving fewer and less complex drilling sequences you can select from among three speedfeed controls that help make the machine more productive: Pre-select, Power range Pre-select and Partial Pre-select.

And in manual control, Carlton's simplified pushbutton control head is the most modern in design and easiest to operate.

There's no compromising at Carlton... where you select the radial drill that fits your requirements exactly. Write today for bulletins describing the sizes you need. The Carlton Machine Tool Co., Cincinnati 25, Ohio.

need. The Carlton Machine Tool Co., Cincinnati 25, Ohio.

Specialists in radial drills

#### New, large capacity New Britain bar machines

If you feel you know New Britain bar machines like a book, a word of caution: There's a completely new book! New, basic design that removes limitations formerly inherent in bar machine construction. New power, new speed, completely new capability for imaginative tooling.

And new, large bar capacity. That is the important "new" we want to call to your particular attention here. You can apply New Britain standards of productivity to bar stock as large as 51/8".

The new, big line of four-, six-, and eightspindle models:

Model 450. Four spindles, 51/8" maximum capacity, four independently operated radial cross slides.

Model 635. Six spindles, 3½" capacity, with independent radial cross slide in every position.

Model 826. Eight spindles, 25%", capacity. Six independently operated cross slides with the two lower slides exceptionally wide to provide elevating blocks for cross slide tooling in the number 3 and 8 positions.

Inexpensive, disc-type cams provide positive actuation of cross slides. Cross slide and end-working tools on all models are easily accessible. All models have positive spindle carrier lifting, locating and locking. New catalog material will give you further details on these machines. Your New Britain representative can show you how the increased profitability built into them can improve your competitive situation. Plan to see him soon.

THE NEW BRITAIN MACHINE COMPANY

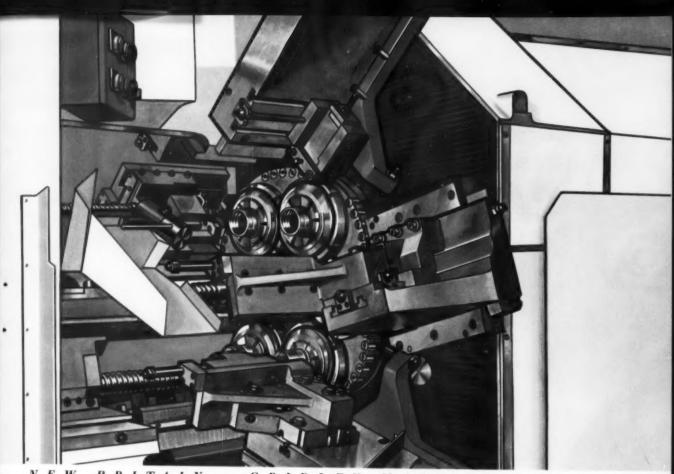
#### Capacity up to 15" on New Britain chuckers

We are going to take it for granted that you take New Britain chuckers for granted—as the leading make of multiple spindle automatics. Most people do. The big news then is that the profitability of these famous machine tools can now be applied to an increased range of work. The new New Britains are available with chucking capacities up to 15", which enables you to apply New Britain standards of speed, accuracy and versatility to larger work.

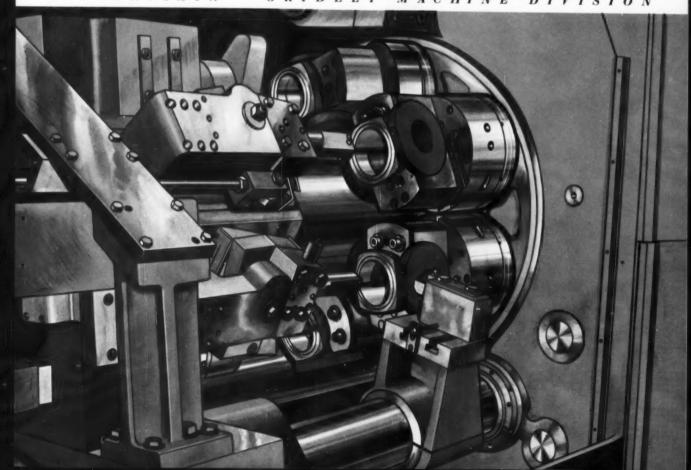
The 15" capacity applies to four-spindle models. Six-spindle machines will take pieces up to 12", and eight-spindle chuckers will handle up to 10".

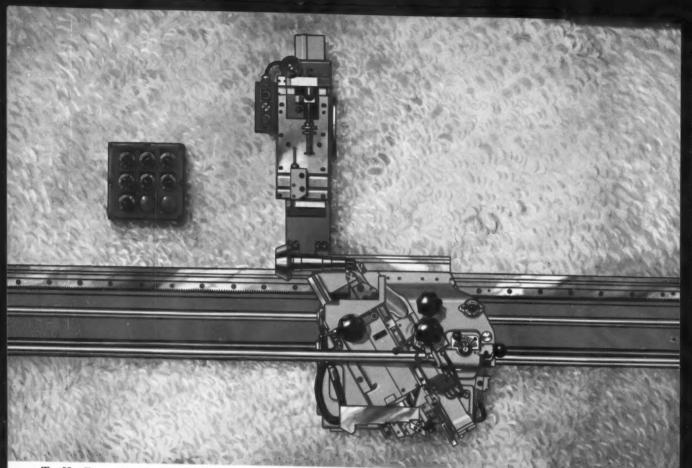
If you work with large castings and forgings, this might be the announcement of the decade, in terms of an investment that can't fail to be profitable. With equipment like this properly adapted to your particular requirements, nobody, anywhere, is going to trim you on cost per piece.

Call on your New Britain sales engineer for practical, specific information, of course. Meanwhile, we have just published a new catalog on these new large capacity chuckers, and we would be happy to mail your copy to you on request. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

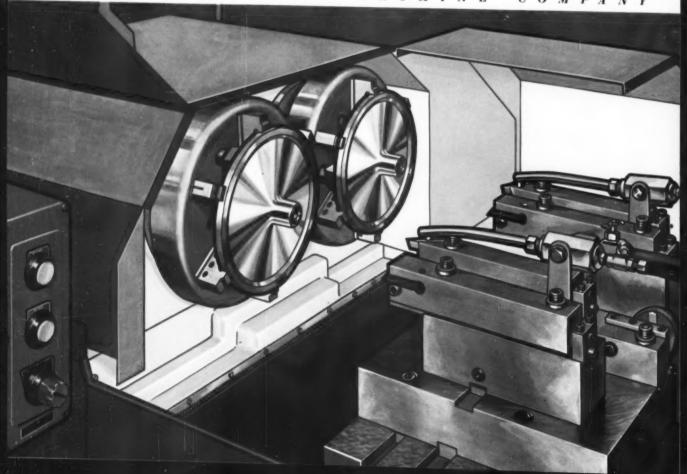


NEW BRITAIN - GRIDLEY MACHINE DIVISION





THE NEW BRITAIN MACHINE COMPANY



#### Fast, rugged New Britain +GF+ copy lathes

Right from the ground up the New Britain +6F+ is a machine conceived, designed and manufactured as a copying-contouring lathe. Not a standard lathe with copying attachment; not a factory-made "special" with the contouring feature built on components from other lathes; but a solidly based, ruggedly constructed, fast, powerful, accurate machine designed solely for the template-controlled, rapid production of between-centers or chucked work with external or internal contouring.

A million pieces or just a few, it's a machine you'll use on many different types of short-run jobs (just change the template and reset the controls), or on one long-run job (just replace the single-point tool when it wears).

The instantaneously accurate hydraulic copying

mechanism is entirely enclosed within the compact carriage. All controls are within easy reach. The template is up front for easy adjustment. The chips fall free into the wide open base, can't clog or jam any part of the mechanism.

There are endless variations available within the New Britain +6F+ line. The standard model has applications anywhere on between-centers or chucked pieces. Other attachments and models are available to suit your particular requirements; infeed attachments, automatic loading, bar stock models, etc.

Don't buy any lathe or "special" for copy turning until you have investigated the New Britain +6F+ copy turning lathe. As a starter, may we send you the latest catalog?

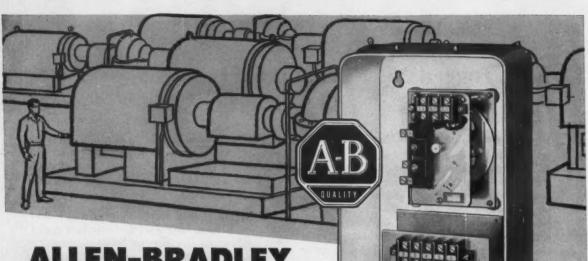
#### NEW BRITAIN . GRIDLEY MACHINE DIVISION

# Consistent accuracy to tenths at super speeds

Model 37 Precision Boring Machine is a machine with a mission, rather than an answer to everybody's metal turning problems. Its mission is contour boring and turning in applications where both extreme repetitive accuracy and high production are of paramount importance. If you have such a requirement, Model 37 is an unbeatable money-maker.

It is an inherently simple machine: simple to operate, with inspection limited to gauging any one dimension. Simple in operating principle, too, built around precision cams that operate without being affected by temperature fluctuation. From one to four high speed spindles can be mounted on a single machine.

We would be happy to discuss any production problem involving straight or contour boring and turning. We doubt that anyone equals New Britain's know-how in this area, and we have a wide variety of boring equipment, both vertical and horizontal and of very advanced design. No matter what your work, or production requirements, this is a very fine place to look for an answer. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.



# ALLEN-BRADLEY PHASE FAILURE and PHASE REVERSAL RELAYS

will provide positive protection for high-horsepower, high-priced motors!

It's sound "economy" to guard your investment in expensive motors and equipment against the extensive damage that can result from a phase failure or phase reversal. Allen-Bradley's Bulletin 812 Style RF relay provides complete, positive protection against both of these hazards.

The Bulletin 812 Style F phase failure relay instantly detects all open phase conditions on a motor branch circuit and removes the motor from the line—yet is not subject to nuisance dropouts from transient line fluctuations. An unusual feature of this Style F relay is its positive response, regardless of motor load or type of motor branch circuit employed.

The Bulletin 812 Style R phase reversal relay disconnects the motor from the line—whether it is running or not—when a phase reversal occurs on the line side of the relay. Thus, it can be used to protect a single motor or a group of motors. Furthermore, the Style R relay removes the motor from the line should a phase failure occur while the motor is stopped.

All A-B Bulletin 812 relays are completely "fail safe." It will pay you to investigate this economical insurance against the heavy losses that can—and frequently do—result from phase failure and phase reversal. Write today!

Allen-Bradley Co., 1331 S. First St., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



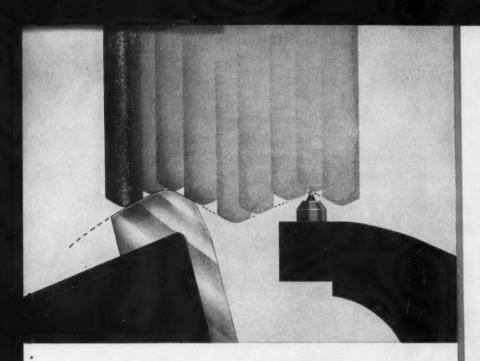
for Phase Reversal

for Phase Failure

ALLEN-BRADLEY

Member of NEMA

Quality Motor Control



#### OLIVER'S FACE MILL GRINDER

#### features automatic wheel dressing with every stroke

The drawing above shows the grinding wheel passing over a cutter tooth after being dressed and formed automatically by a fixed diamond. This happens with each stroke of the Oliver automatic face mill grinder. This exclusive Oliver of Adrian feature permits carbide grinding with a silicon carbide wheel. Automatic feed-down accurately compensates for each dressing thus providing a fixed grinding line which insures a minimum of run-out.

The machine automatically indexes the cutter and controls the tooth shape by a simple cam arrangement so that any practical roughing or finishing form can be obtained. Oliver's face mill grinder is hydraulically operated for smooth, fast (4 to 8 times faster per cutter), accurate and trouble-free performance.

In addition to the automatic machine, Oliver also produces a hand operated, heavy duty machine for all types of face mill grinding on coarse and fine pitch cutters from 4" to 24" in diameter. Still a third machine in this general family is the Oliver No. 2 Arc Radius Cutter Grinder for face mills and cutters requiring a radius on the corner.

Oliver will grind face mills on a "no charge" basis as a demonstration of the ability of the machines. We'd like to work with you-write today.

#### OLIVER of ADRIAN

1410 E. Maumee St. . Adrian, Michigan

DRILL GRINDERS AND THINNERS-TOOL AND CUTTER GRINDERS-AUTOMATIC AND MANUAL FACE MILL GRINDERS-TOOL BIT GRINDERS-CONTOUR SAWING AND FILING MACHINES.

#### A "TRIPLE CHECK" FOR FACE MILLS

To obtain peak performance in your face milling operations you must be certain to achieve (1) maximum cutter life, (2) lowest possible micro-inch reading on the surface being milled and (3) the most economical method of sharpening the cutter.

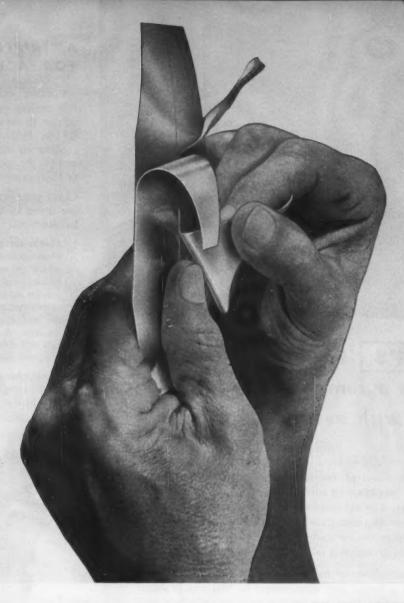
Check your performance to see if you are using all three of the following helpful hints:

- 1. Maximum cutter life requires the elimination of all sharp corner angles which are normally subject to early breakdown. The Oliver face mill grinder automatically incorporates a corner radius between the face and the lead angle thus correcting this situation. A test grind on your face mill will show a substantial increase in pieces milled per grind.
- 2. For the finest finish a radius should be used on the face rather than a straight line grind. The face radius



(40" to 100") eliminates the line contact which is largely responsible for the rougher milled surfaces. Standard cams include this feature automatically on the Oliver machine.

3. Minimum grinding costs require the use of fast, automatic machines capable of using semi-skilled operators. The Oliver face mill grinder provides for complete automatic operation, including the indexing as well as the grinding of the lead angle, corner radius, face, dish and the removal of the soft steel backing on carbide tipped cutters. The automatic up-feed of the cutter is an optional feature.



#### Ever see anything so versatile as **IAMINUM**°?

Generally, laminated shims of LAMINUM are custom stamped to blueprint specifications. Because the laminations are so easily p-e-e-l-e-d to bring the shims down to desired thickness, LAMINUM shims are used universally on assembly lines where they save time and cut costs.

But occasionally you run into a special situation

—the need for a shim of varying thickness, for example. LAMINUM solves that problem with cost cutting ease. As illustrated, the shim is scored into quarters. Then layers are p-e-e-l-e-d from the to correspond with variations in the job at hand. That's LAMINUM! It's fast. Practical. Precise. No need for stand-by equipment. No machining. No grinding. No counting. No stacking. No mik-

ing. And no grit between layers—ever.

For quick estimates and service, send your

quarters so as to come up with varying thicknesses

prints to the Laminated Shim Company, Inc. West Coast Sales and Service 600 Sixteenth St., Oakland 12, Calif. Home Office and Plant 3906 Union St., Glenbrook, Conn.

7.8-

LAMINUM is the registered trade name for Laminated Shims with layers completely surface bonded to look and act like solid metal. Design Folder No. 3 contains all facts and engineering data. Send for it.

- Export-Import Balance Poses Problems
- Machinery Exports Up; Further Gains Likely
- Defense Contracts—Incentives, Advertising



#### Keeping up with Washington

#### Loring F. Overman

ONE of the knottiest problems facing Washington involves foreign trade. On one side of the coin, foreign-aid programs encourage nations to pull themselves up by their bootstraps through the production of goods for export. Technical know-how is provided, together with cash, credits, and such United States equipment as machinery for industry, agriculture, and construction.

The other face of the coin involves the eventual entry of overseas-produced goods into the continental United States, as well as into overseas markets served by United States manufacturers. Usually the overseas producer offers a substantial price advantage.

Members of Congress, particularly those representing areas running up distress signals as a result of the programs, are being asked to take a second look. Unfortunately, the possibilities for conflict of interests are all too apparent. The Commerce and Labor Departments seek to encourage exportation of American-made goods and machinery. The State Department, in studying problems spawned by imports, must also be concerned with keeping international relationships on an even keel. The Internal Revenue Service is concerned with keeping tax revenues high through business profits and income taxes of employed individuals.

These and other conflicting circumstances were under grave consideration as Congress began debate on an Administration request for \$4,200,000,000 in foreign-aid authorization. House action sliced the request by \$137,000,000 while a Senate Foreign Relations Committee trimmed \$30,000,000. Final appropriation was expected to be at least \$500,000,000 below the initial request.

#### Machinery Exports Up; Further Gains Likely

The National Machine Tool Builders' Association has reported a significant trend in export orders for metal-cutting type machine tools. March export orders amounted to \$12,200,000, while these orders amounted to \$33,900,000 for the first quarter of 1960. This was 24 per cent of all net new orders.

Export orders during the last six months accounted for 21 per cent of totals compared with 13.1 per cent for the year 1959; 17.2 per cent for 1958; 11.1 per cent for 1957; 10.3 per cent for 1956; and 8.7 per cent for 1955. From two official sources come indications that a broader overseas market for American goods—machinery and machine tools included—may be in the offing. The ECE—the United Nations Economic Commission for Europe—has recommended in its annual economic survey, that Europe combat creeping inflation by "increasing competition through a greater flow of imports." The report points out that inflation grows with Europe's expanding trade credit balance, and that further efforts to repress demand for United States goods might result in Washington's taking protective measures that could hurt international trade.

Reporting from the other side of the world, another official voice observes that a substantial increase in the Japanese market for American capital goods is in prospect. Source is the U. S. Department of Commerce Trade Mission which toured Japan in mid-April to appraise opportunities for expansion of United States-Japanese trade. The Mission, headed by Joseph A. Mach, recommended that early removal of trade restrictions on imports from the United States is necessary to success of the program.

"Although Japan has made remarkable progress in the last decade, much of its equipment and methods in metal-working and other manufacturing industries is outdated," the Trade Mission director reported. "A start on modernization has begun, but subsequent investments in new machinery and changes in obsolete materials-handling techniques are required if Japan is to keep up with the progress of other industrial nations."

The Mission's specialist on machine tool and production equipment, Jack Kleinoder, New York City, observed that "almost every industry in Japan is badly in need of modern machine tools, qualified engineers to set them up, and trained operators." He reported a keen interest in American tools and equipment, but said that our manufacturers "must do a better selling job and provide better service if they are to take full advantage of the opportunities opening up as Japan relaxes import restrictions."

Another facet of the export-import problem is the consideration being given the Boggs Bill to provide tax incentives for American investment abroad. If passed without being limited to investments in backward countries, the measure could spark machine tool sales for American companies setting up tax-favored branches overseas.

#### Defense Contracts—Incentives, Advertising

Machine tool people who are involved in defense contracting, either directly or indirectly, may soon have two additional yardsticks to watch. One concerns incentive contracts; the other, advertising.

The defense contracts matter is in the hands of two Congressional committees. The House Special Armed Services Subcommittee on Procurement Practices in the Defense Department is under the chairmanship of Representative Carl Vinson. Senate studies are in the hands of the Thurmond Subcommittee of the Senate Armed Services Committee.

Many defense contractors would be affected by a proposal to tighten restrictions on the advertising of certain information about defense projects. The directive under study is a result of testimony presented to the House Armed Services Committee. A subcommittee characterized as dangerous and unhealthy any contractor advertising which purported to show the military effectiveness of a weapon or the economic impact of a cancellation upon employes or its subcontractors.





# HARDINGE EASY READING BLACK and WHITE DIALS

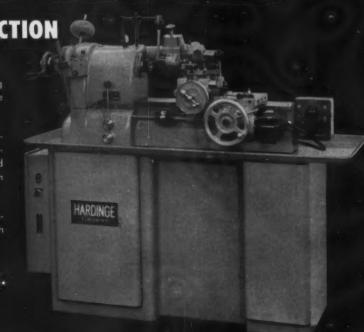
mean INCREASED PRODUCTION

- . . . HARDINGE developed these fast setting easy reading black and white dials — they assure maximum accuracy with high production.

Pioneered with the Hardinge High Speed Precision Chucking Machine model HCT shown here — Hardinge black and white dials are now standard equipment at <u>no extra cost</u> on all of our tool room and production machines.

Invest in Hardinge equipment for product improvement and increased production. Ask for bulletin on our tool room and production machines.

HARDINGE BROTHERS, INC.



# What the Space Age Has Done to Us



WITH the development of the atomic bomb during the closing years of World War II, heralding the birth of the Nuclear Age, completely new and more exacting requirements were thrust upon the metal-producing and metal-working industries. These requirements were far beyond prevalent conceptions of performance, reliability, and accuracy so far as formed and machined metal parts were concerned.

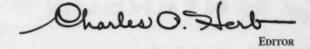
First of all was the necessity for developing metals of tensile strengths and heat-resisting properties much higher than those of materials known at that time. This led to the genesis of the so-called "exotic" metals which immediately presented serious problems in forming and machining, problems for which, in some instances, satisfactory solutions are still being sought.

Manufacturing difficulties led to the development of such unique processes as the hot re-forming of sheet-metal parts produced in hydraulic presses, to the milling of parts while they are subjected to temperatures in the nature of 800 to 1200 degrees F., and to the application of electric-spark machines for metal removal in the formation of minute holes and slots or the finishing of complicated contours on components. Only recently has a machine of revolutionary conception been announced which employs electronic beams in a vacuum for producing ultra-minute holes as small as 0.0008 inch in diameter or narrow slots to extreme degrees of accuracy, in such materials as quartz, tungsten, and zirconium. The same machine welds the exotic metals.

Dimensional accuracy is frequently demanded in millionths of an inch, whereas thousandths were considered the ultimate not too many years ago. This extreme accuracy has led to the production of gage-blocks of greater permanency than those of the past and to the use of such ultra-accurate optical equipment as auto-collimators and microscopes. Obviously, if nuclear vehicles are to arrive at their destinations in the far reaches of outer space within reasonable limits, their components must be accurate dimensionally within minimal tolerances formerly associated only with ultra-precise laboratory products.

That the manufacturing problems of the Space Age are being solved is indicated by the wide variety of articles being presented in this issue of MACHINERY—the Aircraft and Missiles Number for 1960. Attention is directed to such unique developments as the use of radiant quartz lamps for brazing honeycomb metals, the formation of high-strength rocket chambers from paper-thin steel, and the employment of integrally heated beryllium-copper dies for forming refractory metals.

The Nuclear Age is here to stay. All of its myriad manufacturing problems will eventually be solved.





#### WIDEST SELECTION

At Riverson you choose from the nation's largest and most diversified stocks—available to meet your smallest or largest needs.



#### HELP IN SELECTION

Your Ryerson representative can recomm best aluminum alloy for each application to do the job faster, better—at less cost.



#### HELP IN FABRICATION

Experienced aluminum specialists are always ready to assist you with technical fabrication problems.



#### Sheets

All thicknesses, alloys and tempers cut to any size.

Thicknesses from .008 to .125—slit to any width . . . cut to any length,

Thicknesses from .250 to 4". Also tool-

#### Rod

Rounds, 1/8" to 8" dia., cut or stock sizes; hexagons, 1/6" to 3" dia.

Squares, 1/4" to 4" dia.; rectangles, 1/6" x 3/8" to 3" x 6".

#### Structural Shapes

### Angles, channels, tees and i-beams.

Extruded Architectural Shapes Angles, channels, tees, 1-beams, thresholds, sills, handrails, gravel stop, and coping.

#### **Tubing and Holobar**

Round, 1/4" to 6" diameter. Also square and rectangular tubing.

1/2" to 6" diameter, to 20' lengths.

#### **Roofing and Siding**

Corrugated, insulated wall, V-beam, ribbed siding, roof deck-plain or embossed. Accessories, too.

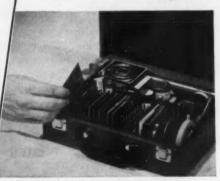
#### SHEET PLAN

eliminates scrap. We can produce exact lengths and widths from coil stock for most users—usually on a net-weight basis.



#### DEPENDABLE DELIVERY

Finest care in handling and packaging and production-line-timed shipments assure fastest service. Any quantity—when you need it.



#### BE "METALOGICAL"

All of Ryerson's many extras and advantages add up to one big plus value for you: optimum value for every purchasing dollar. So be "Metalogical"—call Ryerson.





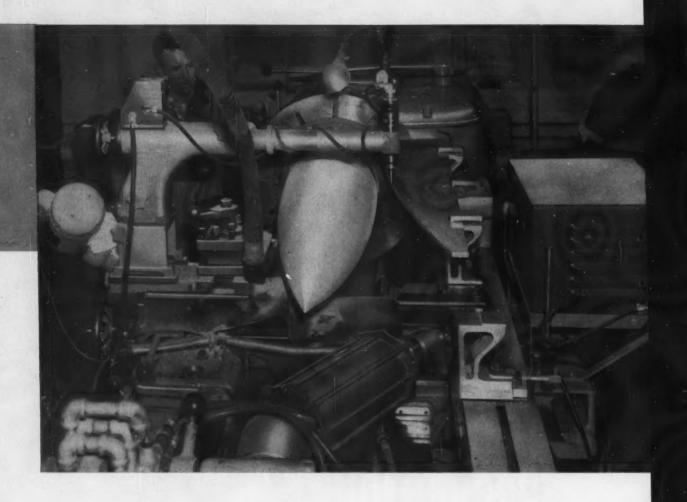
STEEL · ALUMINUM · PLASTICS · METALWORKING MACHINERY

Joseph T. Ryerson & Son, Inc., Member of the ANIAND Steel Family



PLANT SERVICE CENTERS: BOSTON - BUFFALO - CHARLOTTE - CHICAGO - CINCINNATI - CLEVELAND - DALLAS - DETROIT - HOUSTON - INDIANAPOLIS LOS ANGELES . MILWAUKEE . NEW YORK . PHILADELPHIA . PITTSBURGH . ST. LOUIS . SAN FRANCISCO . SEATTLE . SPOKANE . WALLINGFORD 20th
MISSILE and
AIRCRAFT
PRODUCTION
NUMBER

JUNE 1960



# Modern Raytheon techniques provide . . . EYES FOR THE HAWK

RAYMOND H. SPIOTTA Associate Editor

All guidance systems for U.S. Army Hawk ground-to-air missiles are being turned out by Raytheon at its Andover plant. With no hesitation, the latest in equipment and techniques has been adopted to assure necessary product quality and reliability while obtaining desired quantities in a minimum of time. Highlighted are some of the more interesting operations on several parts from laminated glass-fiber radomes to aluminum and magnesium forgings

PERHAPS more than in any other single field, up-to-date tooling, equipment, and techniques can be found in greater abundance in those plants devoted to the production of aircraft and missile components. Raytheon's Missile Systems Division at Andover, Mass., is no exception.

Raytheon holds the prime contract for the entire Hawk weapons system. The Hawk is a U.S. Army ground-to-air missile—17 feet long and 14 inches in diameter—that has the ability to seek out and destroy low-flying enemy attackers, even at tree-top levels. It is also being used by the U.S. Marine Corps, and has been adopted by NATO countries.

Its unique radar system automatically tracks

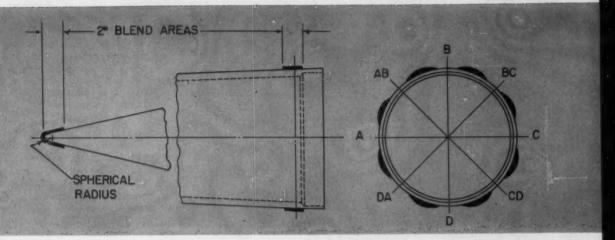


Fig. 1. (Left) One of eight lengthwise lobes required around the glass-fiber radomes is being turned on this tracer-controlled lathe. Seven additional lathes are used for each part, one being set up for each lobe.

Fig. 2. (Above) Radome seen being machined in Fig. 1.
Lobes are exaggerated. Layout lines represented by
letters (A), (B), (C), etc., are aligned with a witness
mark at the base of each offset mandrel.

the target, ignoring unwanted reflections from stationary ground objects such as tree tops, hills, and buildings, in what is normally the blind zone of conventional radars. This semi-active radar-homing missile will complement the nation's defense against high-altitude air attack provided by the Army's Nike system. An interesting aside: the Hawk recently made history by intercepting and destroying another supersonic missile in flight on its first attempt.

In the nose of the Hawk is a small scanner that picks up and locks on the target. By means of an integral hydraulic control system, mechanical movement of the scanner keeps the missile on course. This article will highlight some of the more interesting processes employed in manufacturing the airborne radar unit.

#### **Eccentric Turning Yields** Surface Pattern on Radomes

Contrary to what might be expected, the laminated glass-fiber radomes are not completely circular in cross section. Instead, their surface is composed of eight ridges, or lobes, running lengthwise from just behind the tip to the neck. Even though this surface configuration is required in the interest of electronic transmission efficiency, the radomes are laid-up with a smoothly contoured section.

A bank of eight 25- by 96-inch Axelson lathes is used for turning the radome, one machine (such as that shown in Fig. 1) being set up for each lobe. The part is pushed onto a full-length mandrel—that is, one that matches its interior

contour and dimensions—by an air cylinder carried on the tailstock. A thin, rubberized coating on the mandrel eliminates the possibility of slippage during the operation.

When mounting the radome on the first machine, a layout line at the neck of the part—representing surface B, Fig. 2—is aligned with a witness mark at the base of the mandrel. To obtain the lobe effect the mandrel is positioned off-center a distance of approximately 0.200 inch. Also, to force the tool to follow the desired contour as it feeds along the nose cone, a tracer attachment is employed. This unit is a Raytheon electrically controlled, single-motor duplicator. A rail extending along the rear of the lathe supports a long flat template.

A single-point carbide-tipped tool is fed at 0.012 ipr while the work rotates at 274 rpm. It requires about thirty minutes to complete the turning operation that forms one lobe, while holding the wall thickness to 0.001 inch more than that specified. Although the radome is presently removed from the mandrel by hand, it will, in the future, be pushed off by an air-actuated ring encircling the base of the tool.

After removal from the first lathe the radome is placed on a fixture and sanded to the desired wall thickness. It is then inspected and set up on the second lathe in the bank where, in an operation similar to the one just described, surface D (Fig. 2) is turned. The part travels from machine to machine until the remaining surfaces—A, C, AB, BC, CD, and DA, respectively—have been completed, forming a definite eight-lobed pattern on the outside of the nose cone.



Fig. 3. (Left) After all lobes have been machined, wall thickness of each radome is carefully checked to a tolerance of 0.002 inch. This multiple-dimension air gage measures wall thickness at twenty-three points simultaneously along one trough, a total of 184 points when all eight rows have been checked.

Fig. 4. (Below) Magnesium gimbal rings such as this support the radar scanners in the nose of the missiles. A great deal of the work on these permanent-mold castings is done on the four-spindle, template-controlled, profile-milling machine shown in the following three illustrations.

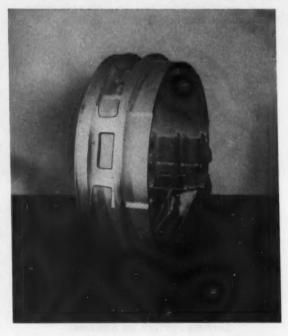
Each radome must be carefully checked for final wall thickness which is held to a total of 0.002-inch tolerance. This is done in a minimum of time (a few minutes per part) on a multiple-dimension Sheffield gage, Fig. 3. Wall thickness is measured at twenty-three points simultaneously by opposed pairs of matched Plunjet cartridges, half of which are mounted on an outer casting of the gage and half on an inner casting. The air-gage cartridges are connected to a remote, twenty-three-column Precisionaire instrument. Float pattern within the columns shows whether the wall thickness at each point is acceptable or, if not, the amount it is out of tolerance.

A sliding plastic "Airechart" across the face of the instrument is engraved with color-coded minimum and maximum tolerance lines that also define the angular position of the radome. When each line of points has been checked, the part is rotated to bring the next line into position for measuring, and so on until all eight rows—a total of 184 points—have been contacted.

#### Gimbal Rings Profiled Four at a Time

Radar scanners for Hawk missiles are pivoted in magnesium gimbal rings such as the one shown in Fig. 4. Much of the machining on these permanent-mold castings is accomplished on a four-spindle, Cincinnati profile-milling machine. Depending on whether the gimbals must be held in a horizontal or vertical position, two or four spindles cut at the same time. In the former setup, Fig. 5, thread clearances are being profile-milled in several places around the periphery of two parts simultaneously.

A typical four-at-a-time setup, Fig. 6, involves profiling in five different planes. Here, three



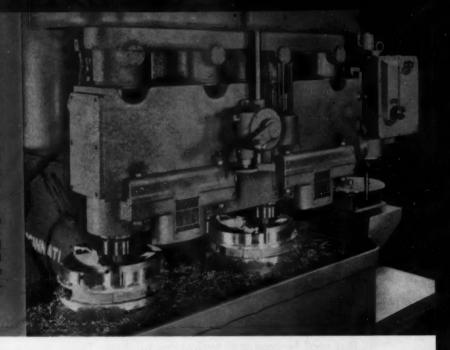
openings through the casting wall in addition to five slots are finished with all spindles active. To do this, 1/4- and 5/16-inch-diameter end mills of solid carbide are run at a speed of 1900 rpm and are fed at a rate of 15 ipm, while cutting approximately 0.250 inch deep. Total cycle time for this setup is 7.8 minutes to profile-mill the three window openings, and 14.8 minutes for the five slots. These figures, of course, represent the times required to finish all four parts as a group.

Longitudinal and transverse movements of the table and cross-slide are controlled by a 360degree automatic profiling unit, Fig. 7, mounted

Fig. 5. (Right) Thread clearances are profiled in several places around gimbal rings. When the parts are held horizontally only two spindles can be used at the same time.

Fig. 6. (Below, left) When the gimbal rings on this profile-milling machine are held vertically, all four spindles can be used simultaneously. In this setup, profiling is being done in five different planes.

Fig. 7. (Below, right) A 360-degree automatic profiling unit that controls movement of the table and cross-slide is mounted at right-hand end of machine table. Shown is the five-plane template unit for gimbals.

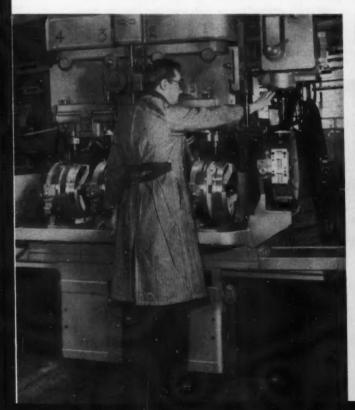


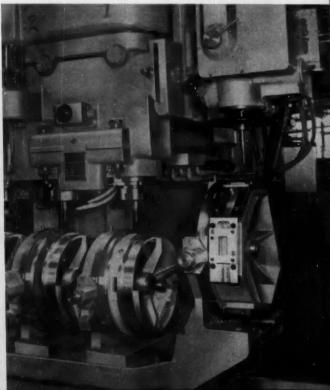
on the right-hand end of the machine. A template carrier—in this case a five-plane assembly—is positioned directly below the profiling unit. The stylus follows the template contour automatically. Its light contact pressure of 1/2 ounce assures accurate reproduction while causing little template wear.

Two 3-hp motors are used in the machine, each driving two spindles. Depth-of-cut adjustments can be made at the time the operation is set up. Six depth stops are arranged in an accessible turret assembly on the front of the spindle carrier and provide a repeatability of

plus or minus 0.002 inch. (Horizontal repeatability can be held to a total of 0.002 inch.) When changing from one cut depth to another, the turret stop is rotated one-sixth of a turn and a control lever is pulled, automatically lowering the spindle carrier to its machining position.

Individual fixtures are designed for manual loading, clamping, and indexing. In the interest of economy in change-over time, all fixtures required for one particular job, regardless of whether two or four parts are to be accommodated, are mounted on a common sub-base. The template carrier is also included on this supple-





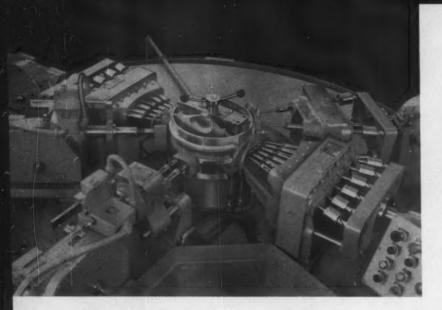


Fig. 8. One of three special horizontal machines used for drilling through the wall of the gimbal casting. This machine has five power-heads—electrically driven and camfed—that drive seventeen tools for drilling, countersinking, tapping, spot-facing, and counterboring.

mental table. When a setup is to be changed, all that need be done is to remove one sub-base and replace it with another complete unit.

Seven different sub-bases, each fully tooled, are used on this machine for various operations on the gimbal ring, a magnesium reflector mounting bracket, and an aluminum cylinder block. When the fixtures are low, as in Fig. 5, a 10-inch riser block is set beneath the sub-base to bring the parts within the working range of the machine spindles.

#### Three Horizontal Machines Complete Gimbal Drilling

Fifty-six holes—both blind and through—are drilled, tapped, and/or counterbored around the wall of the gimbal rings. Raytheon is doing this in a highly efficient way in only three steps. Each step is handled on one of three special Edlund

horizontal drilling machines such as that shown in Fig. 8.

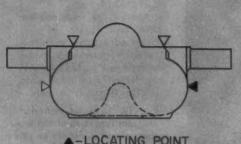
The illustrated machine has five individual power-heads arranged radially about the centrally located work-piece. Spindles of these heads are electrically driven but are cam-fed. Except for those stations at which a single tool is used, all power units are equipped with U.S. multiple-spindle drill heads that carry tool-support bushings on outriggers.

When the gimbal is seated, a handle on top of the fixture is turned, forcing two cam-locks to move out across the upper edge of the part. At the same time, a locating pin extends and enters a previously finished hole in the work-piece.

In this operation a total of seventeen tools is used: three for tapping, two for drilling and countersinking, and twelve for drilling and either spot-facing or counterboring. The drills that are

Fig. 9. A setup similar to that in Fig. 8. Seven heads on this horizontal drilling machine are driving twenty-seven tools positioned around the gimbal ring. Some heads feed with a pecking action which breaks up the chips and clears out the holes.







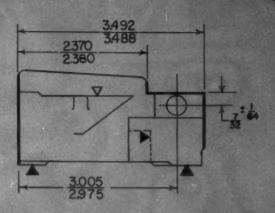


Fig. 10. Forged-aluminum cylinder block is part of the hydraulic circuit controlling the yaw of the missile. Denoted by heavy lines are the four surfaces shown being gang-milled in an initial operation in Fig. 11.

carried by three of the five drill heads converge on the gimbal to provide a truly radial direction of movement. As all the drills at each station receive their rotary drive and horizontal feed from the single spindle of their respective power-heads, they are linked to a drive-block on the end of the main spindle by means of universal joints, Fig. 8.

A similar setup is shown in Fig. 9. Here, seven heads driving twenty-seven tools are positioned around the gimbal ring. The work is secured to the fixture by sliding cam-locks as before. At the touch of a button, all heads move in together to drill six holes, drill and counterbore seventeen more, and drill and countersink another four. Some heads are set up to feed with a pecking action, making three advances and three retractions before finishing the holes. Four heads on a third machine of the same type drill twelve holes to complete the gimbal ring.

#### Machining of Cylinder Blocks is Dial-Programmed

Forged cylinder blocks of 7075 aluminum are a major component in that part of the hydraulic system controlling the yaw of the missile. In an initial operation, four surfaces (heavy lines, Fig. 10) are gang-milled simultaneously on the Mil-waukee-Mil shown in Fig. 11. This is basically a rise-and-fall bed type machine having a maximum spindle speed of 2000 rpm.

Going beyond this simple description, the machine also provides for automatic production milling. The operator can dial-program machine functions on a Dial-a-Cycle control panel, seen in Fig. 12, by phase-switch dials. There are ten of these phase selectors on the control panel, each having the following six settings: cycle reset, cycle stop, table right, table left, head up, and head down. Any number of functions can

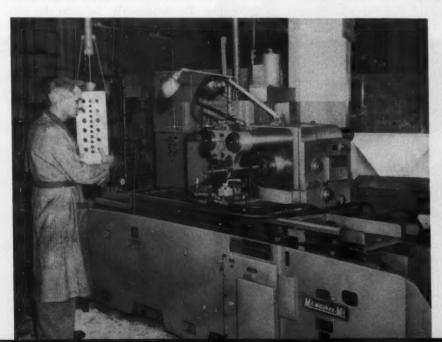


Fig. 11. Cylinder-block forging (Fig. 10) is undergoing initial machining. Ganged cutters finish four surfaces simultaneously in one pass of the table. Although basically a riseand-fall bed type machine, this installation also permits automatic production milling.



Fig. 12. Operator can dialprogram functions of the machine shown in Fig. 11 on this Dial-a-Cycle control panel. There are ten phase selectors on the panel, each having six settings which control cycle resetting and stopping, direction of table movement, and direction of head movement.

be included, such as automatic quill retraction, rise and fall of the head, and tracer control.

In the illustrated operation the rough forging is placed in fixture, Fig. 13, and clamped. The fixture is hydraulically operated to facilitate loading and unloading. Ganged on the horizontal arbor are two eight-tooth, 7.5-inch-diameter (T-15 high-speed steel) side-milling cutters and two eight-tooth, 4-inch-diameter slab-milling cutters. With the arbor rotating at 598 rpm, the work is fed past at a rate of 6.07 ipm, and a cut approximately 0.125 inch deep is taken. The operation is completed in one pass.

#### Cylinder-Block Trunnions Roughed and Finished on Four-Spindle Boring Machine

One of the later operations performed on the cylinder blocks just described involves the machining of a pair of opposed, but otherwise identi-

cal, trunnion arms. Illustrated in Fig. 14 are two of the partially completed blocks. The one at the left is shown before the trunnions have been machined; the one at the right, after.

For this operation a four-spindle Heald Bore-Matic is used, with the fixture-shuttle traveling between the two pairs of opposed heads. The forging is placed in the fixture and located by a vertical pin that enters a large cross-bore in the part (shown facing upward in Fig. 14). It is secured at its base by a spring-loaded clamp, and at the opposite end by a screw clamp and hand knob, as can be seen in Fig. 15.

Cuts to be made on the trunnions include a group of three grooves on each, Fig. 16. Circular carbide-tipped form tools are mounted on each of the four spindles for this purpose. During roughing, the spindles rotate at a speed of 3240 rpm; while for finishing, the speed is increased to 3600 rpm. To dynamically balance the off-

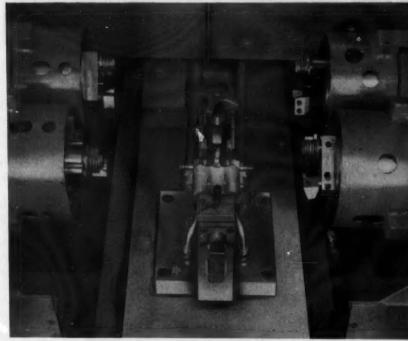


Fig. 13. A closer view of the tooling used to machine the cylinder block (Fig. 11). The fixture is hydraulically operated to speed loading and unloading. Two of the tools are 7.5-inch-diameter, sidemilling cutters running at 598 rpm while the table feeds by at 6.07 ipm.

Fig. 14. These cylinder blocks are the same as the one in Fig. 10, except that much machining has now been completed. The block at the left is shown before the trunnion arms have been turned; the block at the right, after.



Fig. 15. Cylinder block is secured in a fixture that shuttles between two pairs of opposed heads. Carbide-tipped circular form tools on each head machine the trunnion arms—the heads at the rear for roughing; those at the front for finishing.



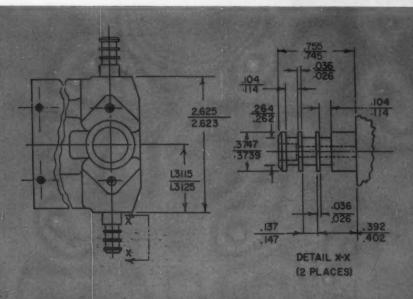


Fig. 16. Illustrated are the cuts taken on both trunnion arms. Although—with the exception of the shoulder locations and arm diameters—drawing tolerances are not especially rigid, a runout of 0.001 inch T.I.R. is maintained between the two trunnion arms.



Fig. 17. Usually separate operations, milling, drilling, countersinking, and reaming are performed in one setup on this tape-controlled machine. Two forged-magnesium gimbal blocks are fixtured together on the same pallet and are machined under the direction of the same tape. A second pallet, right, supports a reflector mounting bracket (spider) which is finished in the same setup.

center cutters (form, chamfering, and facing tools), brass-encased lead counterweights are also mounted on the faces of the high-speed spindles.

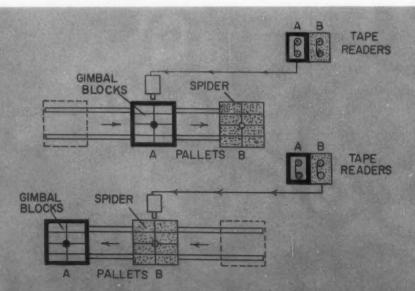
With the work fixture at the rear position, both trunnions are rough-turned approximately 0.010 inch oversize, the shoulders and ends are rough-faced, and the grooves rough-formed. The fixture advances to the forward position where the second pair of spindles takes over. Here, the trunnions are finish-turned to a diameter of 0.3747 –0.3739 inch, the shoulders and ends are finish-faced to the 0.775–0.745 and 2.625–2.623 dimensions while holding the basic starting dimension of 1.3115–1.3125 inches, and the ends of the arms are chamfered.

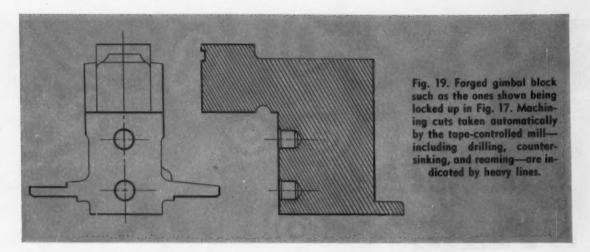
Tolerances in this operation—which requires a floor-to-floor time of three minutes—are carefully held. Although individual blueprint dimension tolerances do not appear to be especially close, with the exception of the main trunnion diameters, plus or minus 0.0005 inch is held across the shoulders and a runout of 0.001 inch T.I.R. is maintained between the two trunnion arms.

#### Variety of Tape-Controlled Cutters Finish Magnesium Forgings

Milling, drilling, countersinking, and reaming—usually separately tooled operations—are handled in but one setup on the tape-controlled Milwaukee-Matic shown in Fig. 17. The part being locked up is a forged-magnesium gimbal block. Simple fixturing is used, that illustrated being of dual design to accommodate two forgings at the same time. Also, the work-table can be indexed to any one of eight 45-degree positions

Fig. 18. Two different parts can be machined in one setup through use of a two-pallet shuttle in the work area and two separate tape readers in the console. Tape (A) controls machining on pallet (B) is loaded. Tape (B) controls machining on pallet (B), bottom, while pallet (A) is reloaded.





to provide complete accessibility to the cutters.

A second work-table (right) is used to hold another part—a reflector mounting bracket, or spider. Two features of the machine make it possible to work two different parts in the same over-all setup. These are the use of two tape readers housed in the same console, and the use of a pallet shuttle in the work area. The pallet shuttle allows automatic reciprocal operation between the two pallets supporting the two groups of fixtures.

Functioning of the two pallets in conjunction with two General Electric Mark II tape readers (using standard 1-inch, eight-channel punched tape) is brought out diagrammatically in Fig. 18. In the upper sketch tape A is being read and is controlling the machining of the gimbal block on pallet A. Meanwhile, pallet B is being loaded.

In the lower sketch the pallets have moved to the left, bringing the spiders on B in front of the machine spindle. Tape B is now being read to control the spider machining while tape A is automatically rewound. At this time, and without interrupting the machine cycle, completed gimbal blocks are removed from pallet A and are replaced with two more rough forgings. An idea of the cuts being taken on each gimbal block can be had by referring to the heavy lines on the drawing in Fig. 19.

All tools for both parts are stored in the automatic tool changer, Fig. 20. Although not all the available storage capacity is required for the

two parts mentioned, the machine can accommodate thirty-one mixed end mills (up to 2 5/8 inches in diameter), drills, reamers, taps, boring tools, etc.—thirty in the tool changer and one in the spindle. Their selection is based on binary code, thereby permitting the tool-selection device to recognize any one of 961 different tools by means of code rings around the base of the tool-holders.

Two of the tool-holders are especially designed for tapping. They have a floating action over a distance of 5/16 inch to help prevent tool breakage. Shear pins are provided for protection in the event of jamming.

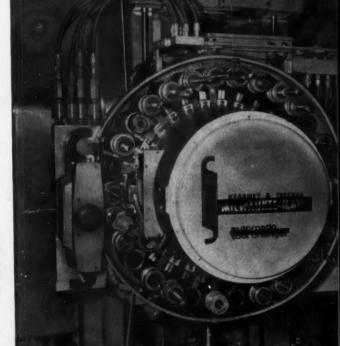


Fig. 20. All cutters required for both the gimbal block and the spider are stored in this automatic tool changer on the milling machine. Thirty tools can be carried in the changer and one in the spindle, giving the machine a total of thirty-one tools from which to select during the reading of any one or two tapes.

# BRAZING STEEL HONEYCOMB BY RADIANT HEATING

CHARLES O. HERB, Editor

"Nortobraze"—a new process that applies radiant quartz lamps to perform an operation in minutes that conventionally takes hours

STAINLESS-STEEL honeycomb cores are brazed to front and back plates also made of stainless steel in order to obtain various types of panels required in the manufacture of advanced aircraft and space vehicles. The large amount of time consumed in brazing such components when the operation is conducted in conventional furnaces has led to widespread investigation of the brazing process on the part of aircraft and missile manufacturers.

Research and experiments conducted by the Norair Division of the Northrop Corporation, Hawthorne, Calif., led to the development of a process known as "Nortobraze." The outstanding feature of this production method is the application of banks of radiant quartz lamps. These lamps are electronically controlled and complete a brazing cycle within two to fifteen minutes, depending upon the complexity of the panels. To perform similar operations in regular furnaces ordinarily takes three to twelve hours.

Nortobraze was invented by Paul W. Warren of Norair's manufacturing research and development group. In addition to the stainless-steel family of metals, the process has been successfully applied to titanium alloys and is applicable to the more exotic metals in the columbium and molybdenum groups which are coming into prominent use in the construction of satellites and interplanetary space vehicles.

In the general view of the brazing equipment illustrated in Fig. 1, the banks of opposing quartz lamps are located at the right-hand end. Each bank has nineteen rows of lamps, as shown in

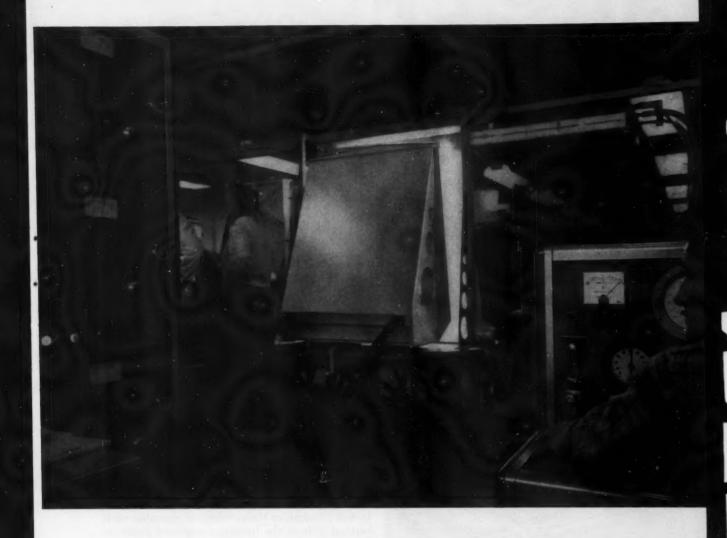


Fig. 2. The rows are about 4 feet in length and alternately consist of two and three lamps of two standard lengths, which gives a staggered effect. Temperatures up to 6000 degrees F. can be derived from these lamps. They are controlled automatically by sensing devices that determine detailed timing and temperature within the honeycomb panels as they are being brazed. Electronic sequencing insures proper time and temperature even when the part has a nonuniform density.

#### Assemblies to be Brazed are Sealed in a Steel Envelope

Brazing operations are performed with the work sealed between two sheets of mild steel which, when seam-welded together, comprise an "envelope." Both envelope sheets have a pocket of the same outline as the work assembly and of sufficient depth to receive the assembly. In pre-

paring for a brazing operation, a bottom plate of stainless steel is placed in the pocket of one envelope. Then a sheet of silver brazing alloy is laid on this bottom sheet.

Next, the honeycomb section is laid on the sheet of brazing alloy, after which still another sheet of brazing alloy is laid on the honeycomb. Finally, another sheet of stainless steel is laid on top. The entire assembly is then framed, with edge members that may consist of Z- or C-sections or other pieces of stainless steel. Obviously, the envelope pockets serve as jigs to locate the work-pieces with respect to each other and to hold the entire unit in a predetermined position for the brazing operation.

After an assembly has been completed, the top piece of the envelope is placed on the bottom piece and the two are seam-welded together to make an envelope that is gastight. There are pipe connections at both ends of the envelope as seen

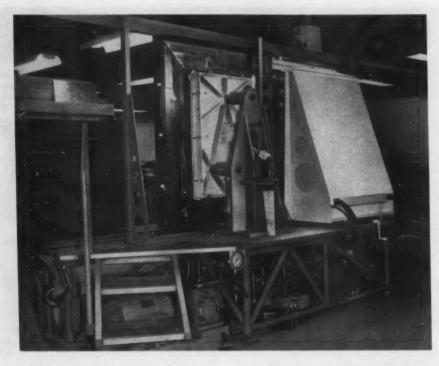
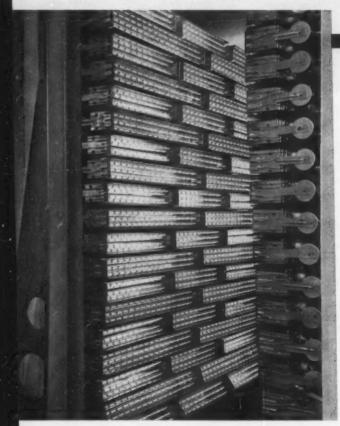


Fig. 1. (Above) Brazing machine for honeycomb sections which employs radiant quartz lamps for developing temperatures up to 6000 degrees F.



at the top and bottom of an envelope in Fig. 3. In this illustration the envelope is mounted on a vertical slide of the brazing equipment ready to be positioned between the banks of quartz lamps.

Before this stage of the operation, however, the envelope is hooked up with a vacuum system and all air is withdrawn through the pipe connections. Then argon gas is admitted into the envelope and a "sniffing" device is employed to determine if there is any leakage. The device is actually an LD 15 leak-detecting tube. Defective envelope welding must be corrected in order to prevent oxygen contamination of the brazing atmosphere. The brazing is conducted in a vacuum of 500 millimeters absolute. This operation is performed within a closed cabinet. Cleanliness of the work parts and a vacuum of the degree mentioned are essential to the success of the brazing operation. Incidentally, the envelope is covered

Fig. 2. One of the two banks of radiant quartz lamps in the Nortobraze equipment.



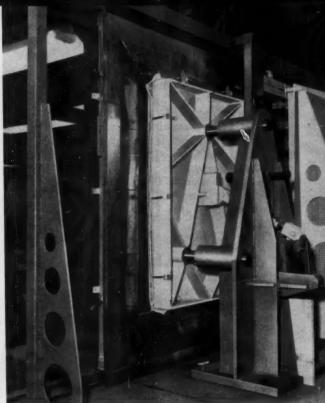


Fig. 3. (Above) Envelope constructed of two mild-steel sheets which contains the honeycomb and other members of a panel that are to be brazed together.

Fig. 4. (Above right) Slide which contains the envelope of work positioned between chilling forms after the assembly has been heated by the radiant lamps.

all over with a paint that promotes high heat absorption.

After the foregoing preparation, the envelope is mounted on the vertical slide as shown in Fig. 3 and moved automatically to the right-hand end of the equipment between the banks of radiant quartz lamps. At this position, power is applied to the lamps and the panel temperature is rapidly raised to a plateau of 1725 degrees F. and held for an interval which depends on the complexity and configuration of the panel.

The build-up to the brazing head is governed by the six-channel power temperature controller,



Fig. 5. Six-channel power temperature controller and strip-chart temperature recorders govern the operations.

and the function generator which follows a preprogrammed time-temperature cycle. The stripchart recorders, shown in Fig. 5, provide a complete record of the heat in each zone of the panel being brazed. The function generator is shown in Fig. 6 with the drawer open to permit a view of the time-temperature programming cylinders. The console in Fig. 7 controls the automatic operation of the machine, the application of argon gas, and the creation of the vacuum. A recorder charts the "purging" cycle.

#### **Chilling Forms Hasten Cooling**

At the end of the prescribed interval at brazing temperature, the part is moved automatically to the center station, as shown in Fig. 4, between two chilling forms that hasten cooling. Normal heat radiation of the die mass is usually adequate for cooling, although water can be circulated through passages in the chilling forms. The envelope is securely held between clamps until the work temperature has dropped to a point where dimensions will remain stable. Upon completion

of heat-treatment, the envelope is cut open around the edges and the brazed panel is removed. The envelope sections can be used again for smaller parts, or scrapped.

In addition to economies and speed of brazing, an advantage of the Nortobraze process is its adaptability to all sorts of configurations. For example, in Fig. 8 is a panel with parallel top and bottom surfaces. The brazed honeycomb is, of course, confined between top and bottom sheets and the structural side and end shapes. Fig. 9 shows a structure that tapers from a height of 5 or 6 inches to a knife edge.

In Fig. 10 the section is curved and, of course, the pockets in the envelope used in brazing this section would be correspondingly shaped. Fig. 11 shows a section constructed with three flat sheets and two honeycomb sections. There are no side-enclosing members in this instance.

The United States Air Force recently announced the awarding of a contract to Norair that provides for the expenditure of almost \$1,000,000 in adapting this automatic brazing process to the manufacture of aircraft and space vehicles.

Fig. 6. Function generator with drawer open to show time-temperature programming cylinders for brazing control.

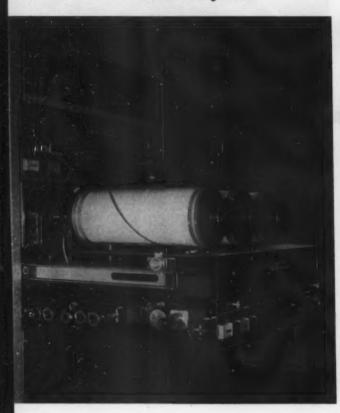


Fig. 7. Cabinet which controls vacuum in envelope feeds argon gas to envelope, and operates the machine.



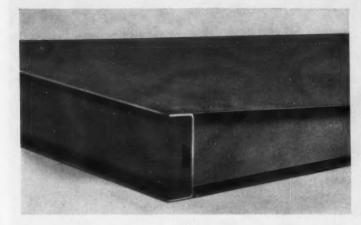


Fig. 8. Panel number which contains steel honeycomb Er. e unit has been brazed in the sour braze machine.

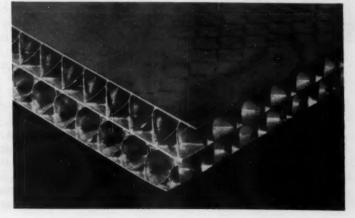


Fig. 9. Another to roomb structure which tapers from eight of 5 or 6 inches to a plant knife edge.





Fig. 11. Section at the tree flat sheets of stainless stee and two honeycomb sections—this are indicates the wide possibility in Nortobraze.





# NORTH AMERICAN READY TO BUILD B-70 PROTOTYPES

Millions of dollars had to be expended to provide the equipment for building the prototypes—equipment that will be ready for immediate use on a large-scale basis if the B-70 program is reactivated

#### CHARLES O. HERB

WHETHER OR NOT the program for building quantities of the B-70 intercontinental bomber will be reactivated at a future date is a decision up to Government officials and the United States Air Force. In any event, the Inglewood, Calif., plant of North American Aviation, Inc., will be prepared to carry out such a program. Millions of dollars have been invested in equipment necessary to build this Mach 3 plane and most of

it has been installed. At any rate, the equipment will be used in producing the two prototypes that have been ordered by the Air Force. These planes could not be built without much of this equipment. For example, a huge bell type furnace that towers approximately 40 feet above a quench pit of similar depth had to be installed.

The B-70 bomber was designed to fly at speeds up to 2000 miles an hour—about three times the speed of sound. Such a speed would carry passengers from New York to Los Angeles,

or vice versa, in one and a half hours. Aviation experts contend that this aircraft could be used not only as a supersonic transport, but also as a high-altitude mobile booster for satellites and space probes and as the nation's initial supersonic nuclear-powered airplane.

This article will describe equipment installed for preparing stainless-steel sheets prior to welding them into skin sections, for welding the sections together, and for planishing seam welds to the required degree of smoothness. For example, Fig. 2

shows a slitting machine built by North American Aviation that will trim sheets up to 16 feet wide accurate within 0.002 inch across the entire width. The cut is made by a 4 1/2-inch diameter cutter about 1/2 inch wide which rolls along the sheet and trims it in similar fashion to the disc type can opener. The cutter-head is fed along the cross-rail through a rack-andpinion drive. The driving motor is mounted directly on the cutter-head. The type of chip produced is seen in Fig. 3, which also clearly illustrates the disclike cutter. To give an indication of the cutting versatility of this machine, it may be mentioned that operators have sliced the cellophane wrapper of a cigarette package as neatly as if it were cut with a razor blade.

Sheets that have been properly positioned for the shearing operation are securely gripped in place by forty pneumatic clamps arranged across the top of the cross-rail as seen in the illustration. It is estimated that these clamps apply a pressure of approximately 700 pounds.

The same machine is used to turn up a narrow flange across the full width of sheets to facilitate butt-welding operations. This lip or flange may be as narrow as 0.012 inch. Generally speaking, the flange is from one to one and one-half times the thickness of the steel sheet. The turned-up edges of two sheets to be welded together eliminate the need of using welding wire. In setting up a sheet for the flanging operation, magnetic blocks such as seen attached to the bed at the left in Fig. 3 are employed. These magnetic blocks have a step on the upper surface to gage the amount of stock that should extend beyond the shearing blade in order to obtain a flange of the desired height. Then the disc-like cutter is replaced with a plain disc that will merely bend and not shear the sheet as the cutter-

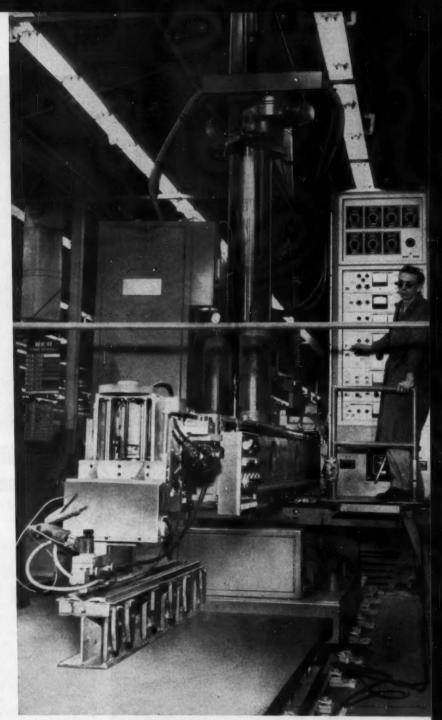


Fig. 1. Huge boom type welding machine that can be moved along a track for performing operations at various points.

head is fed along the cross-rail.

The sheets that customarily

The sheets that customarily are handled by this equipment are PH 15-7 Mo steel, an Armco stainless steel containing molybdenum. After trimming and flanging, they are transferred to the next machine of the line for

fusion butt welding into larger sections. Sheets up to 16 feet wide and of any length can be handled by this Pandjiris machine, which is shown in Fig. 4. It is equipped with a Sciaky welding head and an Airco wire feed. Sheets as thin as 0.006

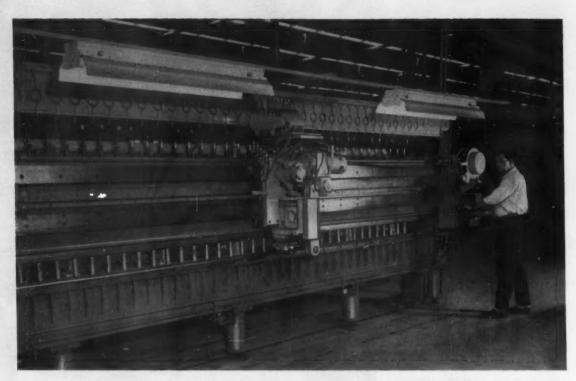
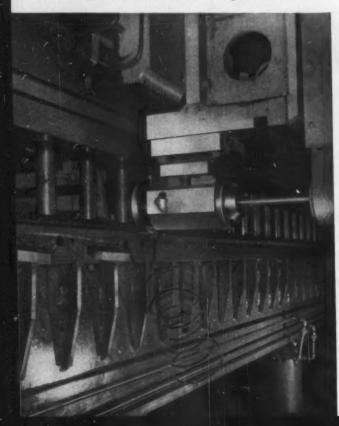


Fig. 2. Machine which trims sheets up to 16 feet wide straight within 0.002 inch and also turns up a narrow edge to facilitate fusion welding.

Fig. 3. Close-up view showing the "can opener" type of cutter used for trimming the steel sheets.



inch and as thick as 0.130 inch are generally handled by the equipment. Either sheets of constant thickness or those tapering from one side to the other can be joined. Sheets of varying configurations can also be welded, there being a seam-tracking arrangement which causes the welding head to follow any desired contour. A close-up view of the welding head and of the welding area is shown in Fig. 5. Brazing tolerances are attained without any reworking. Either helium or argon gas is used.

An unusual feature of this equipment is the provision for preheating sheets to be welded. This is accomplished through a water-heated base on which the edges of the two sheets rest for the operation. These edges are heated to about 150 degrees F. The preheating reduces problems of distortion, cracking, and loss of strength.

A view of the control cabinet for the Sciaky welding head is presented in Fig. 6. This is the transistorized zero-error Sciakydyne drive. It is an electronic counterpart of the rotating amplifier principle. It is by means of this control that the machine can be made to weld tapered sheets or sheets of irregular contours. The control causes

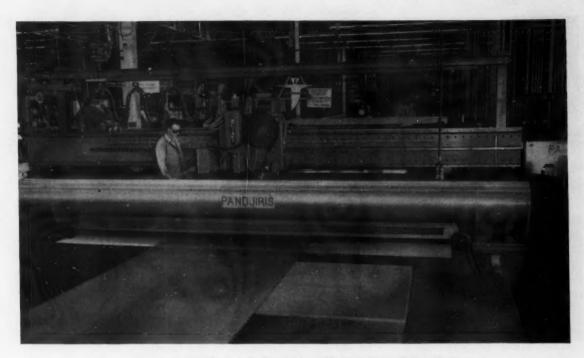


Fig. 4. Welding machine constructed for welding several sheets together to obtain required widths. Any length can be fabricated.

Fig. 5. Close-up view of the welding head on the machine in Fig. 4 which is provided with a seam-tracking system.

Fig. 6. This Sciaky zero-error transistorized control cabinet directs automatic operation of welding machine.

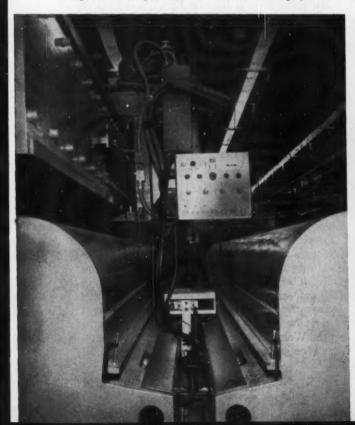






Fig. 7. Planishing machine which rolls down welds to a smoothness comparable to that of a continuous sheet.

the welding torch to rise and fall as desired during its traverse across the work. The cabinet also controls the elevation of the welding head, seam tracking, amount of welding current, wire feed rate, and welding-head travel. The control is designed to make the machine as fully automatic as possible so as to eliminate any element of human error. It insures a constant and dependable arc-welding power supply, and highly accurate welding-speed and positioning controls. It provides a precisely regulated, reproducible, and stepless variation of process parameters.

In setting up the machine for an operation, test specimens about 2 feet long are welded together at an established feed rate. The welded specimen is then thoroughly X-rayed and the results forwarded to the production development laboratory. There the X-ray photographs are studied and the welding parameters are checked, that is, the current, voltage, and other fixed variables. Cracks or weld build-up are observed. A certification sheet previously made out by this laboratory is used ever afterward for all similar jobs. This is part of the quality-control procedure.

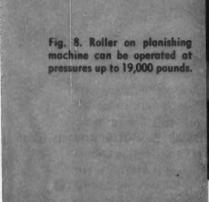
After steel sheets have been welded together by the machine just described in order to obtain large sections, the welds are planished on the special machine illustrated in Fig. 7. The planishing is effected by the use of a hardened steel roller seen in Fig. 8 which is rolled back and forth over

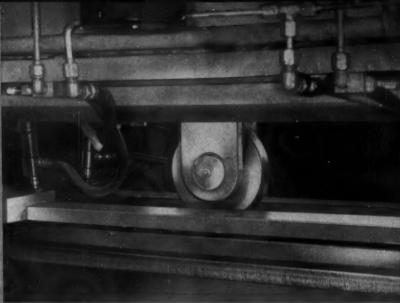
the weld. A pressure can be applied that is variable from zero to 19,000 pounds. The pressure is developed by means of seven pneumatic cylinders mounted on the roller head.

The roller head is traversed back and forth on the cross-rail of the machine to carry the roller to and fro over a weld. The operation is continued until the weld is so smooth that joined sections appear to constitute one continuous sheet of steel. Movement of the roller head is obtained through an individual motor on the head, a Graham variable-speed transmission, and a rack-and-pinion drive. The work is clamped securely by means of hold-down bars that are also hydraulically actuated.

Another feature of this machine is a horizontal hydraulic cylinder at one end which provides for stretching sheets when such an operation is desirable. The cross-rail can be tilted to an angle to accommodate tapered sheets in planishing operations.

Two fully automatic boom-manipulator Sciaky welders of the type shown in Fig. 1 are also representative of the unusual equipment recently installed in this North American plant. The welding head is mounted on the front end of a boom which can be moved in and out on the machine column for welding lengths horizontally up to 12 feet in length. Welds can be made in a vertical plane from 3 feet above the floor level to a height of 10





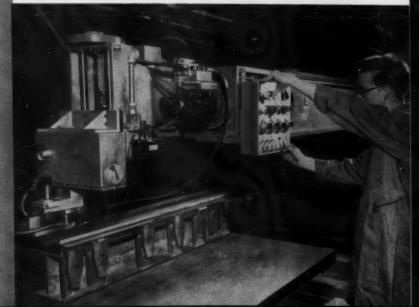
feet. The welding head can be rotated through a full 360 degrees on the front end of the boom.

The welding machine runs on a track 40 feet in length. This provision, as well as the operative features of the machine, provides unusual welding versatility. Not only can sheets be welded along straight lines both horizontally and vertically, but circumferential welds can be made by rotating cylindrical shapes. Internal circumferential welds can be made in ducts to diameters as small as 20 inches. Moreover, welding operations can be performed internally on work as well as externally. One of the boom welders is equipped with a camera on the end of the boom for observing the operation. The pictures are reproduced by a television closed-circuit monitor on a screen that is mounted on the operator's platform. Hence, he can readily see what is happening in confined areas, as well as at points distant from his location.

The boom welders are also provided with the Sciaky zero-error transistorized motor control. A special seam-tracking system maintains alignment of the welding torch directly over the seam being welded. This system is capable of "sensing" a butt joint and then tracing this seam as the head moves. Also, a proximity transducer arrangement keeps the torch at the correct spacing relative to the work.

Fig. 9 shows a close-up view of the welding head engaged in welding sample pieces at the beginning of a new job, in preparation for writing a certification sheet. Tungsten inert gas is being used in welding this quality-control sample and, of course, will also be used in later production schedules.

Fig. 9. Welding head at the front end of the boom on the machine illustrated in Fig. 1.





B-52 Stratofortress

# WALDO\*

as told to . . .
RAYMOND H. SPIOTTA, Associate Editor

EARLY in the planning stages of the B-52 Stratofortress, Boeing-Wichita recognized the future potential of numerical control in the areas of skin and profile milling. Company requirements, together with the requirements of other Air Force contractors, prompted the Air Materiel Command to order substantial numbers of numerically controlled machine tools. As a result, Boeing received its first twelve installations of this type.

Twelve months prior to receipt of the equipment, management began organizing support groups for the over-all numerical-control program. First to be activated were personnel from the tool design, tool and production planning, and data-processing departments. These people worked hand in hand with representatives from other divisions of the company to develop a two-dimension computer program in support of the numerical-control effort. This program, coded for the IBM 705 computer at Wichita, was completed, checked out, and placed in operation in time to provide control tapes for the first skin mill when it was placed in production late in 1957.

When it was realized that a two-dimensional computer program would limit the capabilities of the numerical-control equipment, the writing of a three-dimensional program was authorized. The new program was completed, checked, tried out, and placed in production in the fall of 1959.

### Experience Leads to Inauguration of Subcontract Numerical-Control Program

Background—At the outset of this new venture, a tape-preparation center was established adjacent to the computer center under the direct supervision of the data-processing group. Activity

at the tape center increased by tremendous strides as Boeing's full numerical-control production potential was achieved. This load was further increased by recording magnetic tapes (for a period of nine months) for all airframe manufacturers using the Giddings & Lewis Numericord system. A total of 2100 reels of magnetic tape has been recorded at the Wichita Tape Center during the past two years, 450 of which were for company use.

In addition to this magnetic tape, the tape center has prepared for its own use 1400 punched tapes for three Bendix-controlled profile mills and all the necessary production tapes for four General Drivematic riveting machines. Also, approximately 550 Milwaukee-Matic tapes have been prepared for Boeing's use in the fabrication of 322 production parts. Tape formats and input requirements for additional punched-tape-operated machines, now on order, are presently being studied, and the necessary preparations are being made for the production of the control tapes.

Subcontract program—As a result of requests from outside sources—other users of numerically controlled equipment—Boeing-Wichita is now offering parts programming, computing, tape preparation, tape verification, training, tool design, tool fabrication, and part fabrication through its new Applied Computing Services. Any, or all, of these services are available for subcontract. All of the company's machine tools will be used for subcontract part fabrication on an "as-available" basis.

Application of numerical control to a customer's production needs is a new venture for the company. However, based on three years of pio-

## SPREADS ITS WINGS

A second industrial revolution—created by the use of numerical control—is now in progress at the Boeing Airplane Co. in Wichita, Kan. Many of its machines, directed by either magnetic or punched tapes, are performing various metalworking operations previously done by conventional methods, and some that heretofore could not be done at all. Directing of the cutter path no longer depends entirely on the skill of the operator, but rather on a special numerical-control computer program designed and written by manufacturing and computer specialists. Nicknamed "WALDO"—Wichita Automatic Linear Data Output—this program, refined through years of experience, is now available through Boeing Applied Computing Services for Industries needing two- and three-dimensional machine programming



One of two consoles of IBM 705 computers in operation at Boeing-Wichita in connection with the firm's numerical-control program. Under this expanded program, definite periods of time are reserved for numerical-control computer runs.

neering and production experience in this field, it is felt that this service can be performed with complete satisfaction.

### Some Numerically Controlled Equipment Currently Active in the Plant

There are, at present, some sixteen tape-controlled machine tools in operation at Boeing-Wichita, with preparations being made for several new installations in the near future. A quick tour through the plant, in words and pictures, will give a clear idea of the type of work presently being done, and an insight into other capabilities

that are, perhaps, not so obvious.

In Fig. 1 is shown one of three Kearney & Trecker profile mills having Bendix controls. The part being machined is a forged-aluminum bombrack beam for the B-52G missile-platform bomber. Originally, two of the machines were equipped with high-speed heads and the other with a low-speed head; however, the two high-speed heads have now been replaced with low-speed types. Classified as a three-axes contour milling machine, it has a single horizontal spindle. The column travels longitudinally and carries the saddle-mounted spindle on horizontal ways. An angle-plate serves as a work-holding surface measuring 48 by 168 inches.

One of the desirable features of its control system is a feed-rate-override control. The operator can adjust this to reduce the program feed rate from slightly under 100 per cent down to a minimum of 20 per cent. These three machines have a total of 45,100 hours of production time credited

to them so far.

One of the newest arrivals is the Morey profile and contour milling machine illustrated in Fig. 2. General Electric magnetic-tape controls are used to direct its operation. This three-axes, single-

spindle, planer type machine has a 48-inch-square work-table and sixteen spindle speeds variable from 20 to 3600 rpm. A close-up view of the work area, Fig. 3, shows the contouring of a forged-steel attach fitting for the B-52G.

Five Milwaukee-Matics have recently been installed and placed in production. They are single-unit, horizontal-spindle, tape-controlled machines that automatically perform milling, drilling, reaming, tapping, and boring operations in any sequence, and on several sides of a work-piece, during a single setup. The machines are equipped with standard work-tables which index in 45-degree increments under direction of the tape.

One of the five machines can be seen in Fig. 4. The part being worked is a forged-aluminum fitting member. A before-and-after comparison of the part can be made by noting the two fittings standing on end at the right-hand end of the machine. A better view of the cutting action across the flat surface of the forging is presented in Fig. 5. Note the holes drilled and bored through the part in this same setup. All necessary tools are stored in, and selected from, the rotary automatic tool changer on the right-hand side of the column.

The illustrated machine is equipped with a pallet shuttle that permits one movable pallet to be unloaded and reloaded while the work-pieces on the other pallet are in front of the spindle. When the cuts have been completed the positions of the two pallets are reversed. The pallets can be loaded with the same parts or with two different parts. A setup of this type is controlled by two individual Friden punched-tape readers (in cabinet alongside operator), each one directing the operations performed on one of the pallets.

One of three Kearney & Trecker skin mills with General Electric controls is shown contour-milling a B-52 lower wing panel in Fig. 6. These skin mills are controlled by magnetic tape and are of



Fig. 1. Sixteen pieces of numerically controlled equipment, including three profile mills such as this one, are helping to expedite delivery of the B-52G missile-platform bombers to the Air Force. They also produce most of the templates used on thirteen spar mills.

146

June, 1960

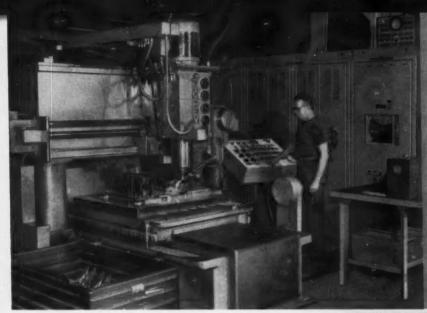


Fig. 2. (Left) One of the newest arrivals in the array of numerically controlled equipment at Boeing-Wichita is this planer type, three-axes profile and contour milling machine with magnetic-tape controls.

Fig. 3. (Below) A forged-steel attach fitting is being contoured in the work area of the three-axes machine shown in Fig. 2. Sixteen spindle speeds are available, from 20 to 3600 rpm.

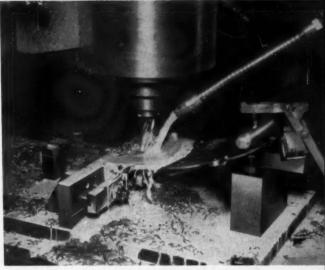
the moving-gantry type. The 65-ton gantry and its supporting ways are independent of its 12- by 80-foot stationary work-bed. Two vertical spindle heads are mounted on vertical ways and, in addition, travel transversely on the gantry cross-rails. This, plus the gantry travel, gives the machines five possible motions and makes it possible to cut two duplicate parts, or two "mirror" opposite parts, at the same time.

#### What Can be Expected from Numerical Control?

Technical discussions of numerically controlled machining, no matter how widespread, can do no more than create further interest in the subject. Those concerned with its possible application in their own plants are, logically, cautious as to what can be expected should the big step be taken: What will it do for them? In an attempt to satisfy this question, some facts will be presented from the records at Boeing-Wichita.

Lead Time—Reduction in lead time is one major advantage. On a B-52 structural wing member only four days were required from the time the engineering drawing was prepared until the work-piece was on the machine tool. This can be contrasted to the twenty-eight days previously required when conventional methods of production were employed.

In the case of a reinforcing doubler, lead time by numerical-control methods was one day; by conventional methods, five days. Time required to machine the first part by tape was 1.2 hours as compared with 25 hours previously. Subsequent machine time per part was 30 minutes as against 6 hours. Final hand finishing on the tapecontrolled part was done in 10 minutes, while 2 hours were needed to achieve the same results on the conventionally produced part.



Flexibility—Flexibility of plant operation is also realized. Part setups on numerically controlled machines can be changed in a matter of minutes, thus helping to balance the work load in the plant. Not only can all types of parts be machined, but various operations can be performed on them—with minimum tooling and handling.

Dollar Savings—Cost reduction is, undoubtedly, a factor of great significance. In the case of a wing panel assigned to a standard spar mill, costs up to the point of actual machining amounted to \$18,467. Costs for the same part (again up to the point of actual machining) when handled on a numerically controlled skin mill dropped severely to a figure of \$1958—a saving of \$16,509.

On a group of similar parts, costs for machining by conventional means ranged from \$3600 to \$7200. After switching to numerical-control procedures, this cost was slashed to an average of \$455, a saving amounting to more than 87 per



Fig. 4. (Left) Five Milwaukee-Matics are located in a single centralized area. These tape-controlled machines are used to mill, drill, ream, tap, and face aluminum, steel, phenolic, and magnesium parts. Two B-52 fittings, before (right) and after (left) machining, are shown.

Fig. 5. (Below) Closer view of the face-milling operation, Fig. 4, on forged-aluminum fitting member. Several holes have already been drilled and bored through the surface of the part in this same setup.

cent. It is interesting to note that if individual tools such as punches, dies, etc., were to be manufactured under a tape program, the money saved in turning out 100 of these would equal the cost of the machine. And the 100 tools could be made in ninety days.

Increased Productivity—More parts in less time—another big advantage of tape-controlled machines. The best conventional machine time obtained on a lower wing panel was 20 hours per part. This was reduced through numerical control to an average of 3 hours per part. In another instance the estimated conventional machine time for a rib web was 7.8 hours. Actual production under tape control required only 2.5 hours.

Reduced Inventory—A composite of all the advantages of a properly applied system of numerical control within a plant, both those mentioned and those not mentioned, yields a little-discussed by-product—reduced inventory. Fewer parts need be kept in stock, with a proportional decrease in attendant paperwork. This can be traced to the several inherent advantages of numerically controlled machining, three of which are:

- 1. Shorter flow time for part fabrication.
- Fewer parts in process at any one time.
   Smaller "economical lot size" due to shorter work cycles.

### WALDO Simplifies Parts and Computer Programming

Maximum benefits of numerical control cannot be enjoyed without an adequate computer program. The operating program at Boeing-Wichita was set up in two phases, the first for handling two-dimensional work and the second, for threedimensional work.

One of the unique features of the two-dimensional program is its ability to compute without regard for the control system on which it is to be used. In the first cycle the computer produces all coordinate points necessary to completely describe the cutter center-line trace, along with the desired feed rates. The second computer cycle uses either a Bendix or Numericord post-processing routine to convert the computed data to a form acceptable as input information to either the Bendix machine control unit or the Numericord director. The simple, straightforward approach in the design of this two-dimensional program has made it easy for the parts programmer to learn and use.

In the development of the three-dimensional

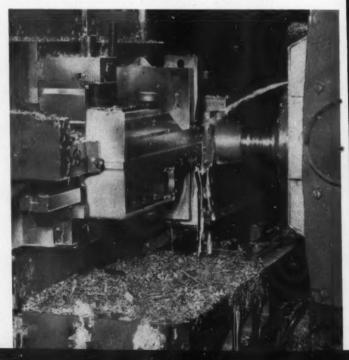




Fig. 6. Three moving-gantry type skin mills such as this one are in continuous operation on B-52 components. The machines, equipped with magnetic-tape controls, are used principally for contour milling on lower wing-skin panels.

computer program, consideration was given to the use of basic input instructions, making sure to use all of the original two-dimensional instructions which could still be made applicable in the new program. The work of the parts programmer was simplified due to increased capabilities of the three-dimensional program and the ease of checking made possible by the orderly arrangement of information on the manuscript. Actual computer time, an expensive item, is reduced to a minimum due to the basic concept employed which limits the computer to a small area of search for the necessary sub-routines. The time required to compute a simple, two-dimensional part through the three-dimensional program has been reduced by approximately 25 per cent as compared with the time through the two-dimensional program.

This new computing technique has been called "WALDO," which is an abbreviation for Wichita Automatic Linear Data Output. The WALDO dimension program is capable of computing data for both the Numericord and Bendix systems for engineering data involving points, lines, circles, planes, conics, and curves in both two and three dimensions.

Given the boundaries of a pocket and a description of the bottom surface, as well as a description of any existing islands, the program is capable of doing all the computing necessary to create the points on the cutter center line, or the trace, for both rough and finish cuts. The parts programmer must specify the amount of step-over desired and designate either a flat-bottom or ball end mill.

Four area routines are available within the computer program which require the use of a ball end mill. By the use of points, lines, circles, curves, and conics, a series of cross sections may be used to describe an irregular area. The cross sections themselves may be either regular or irregular in shape and either parallel or nonparallel to one another, depending on the area routine being used. By describing the boundaries and the amount of step-over, the programmer, through use of the correct code word, causes the WALDO computer program to calculate all the points and establish the cutter center-line trace for complete machining of the irregular surface.

### Work Flow in WALDO Program

General concept of the work process under the WALDO system can be illustrated by a flow chart, Fig. 7. It traces the work flow from its origin in the engineering department through to the individual machine in the manufacturing shop. Clearly shown are the divergent paths, immediately after the computer output punched cards, followed by work intended for programming on either punched or magnetic tapes.

Engineering drawings intended for numerical-control follow-through should have a rectangular, Cartesian coordinate system of dimensioning, with all dimensions referring back to some 0, 0, 0 point for the X, Y, and Z axes. If the drawing is not in this form, the conventional dimensions must be changed to some type of coordinate chart.

A procedure has been established in which the

engineering and manufacturing departments cooperate in determining whether or not a production part, still in the design stage, will be produced by numerical control. If the mutual decision is to make the part by numerical control, the dimensions will be of the coordinate type. If, however, this procedure is bypassed and the drawing is completed using conventional type dimensions, it becomes the responsibility of the parts programmer to convert to the coordinate

type dimensions.

When the engineering drawing of a production part is handed to a parts programmer, he not only accepts the responsibility of writing the program from the drawing, but also must see that coordination is accomplished with all involved groups. The tooling department must design and build a holding fixture for the part or, if necessary, modify an existing fixture. Before doing this, a tentative cutter path must be established so that clamps can be properly located. A setup point must be established so that it can be placed on the fixture and the part programmed from it. It is also his responsibility to make, or have made, an operator's instruction sheet which tells the operator everything he needs to know about the tape and tooling for setup and machining.

A manuscript has been designed for the parts programmer to fit the requirements of the computer program as well as for ease of conversion to punched cards. The vertical columns on the manuscript, Fig. 8, are numbered at the bottom of the sheet to agree with the column numbers on a standard punched card.

Available to the parts programmer is a vocabulary of words to be used along with signs, symbols, and numbers for writing a description of the production part or tool. This vocabulary is actually the key to the WALDO program, each word literally triggering a mathematical process within the computer. It is necessary that the programmer describe the part mathematically in the order in which he wants the machining to take place. In most problems, he imagines himself in the position of the cutter, always looking in the direction of motion. This method of describing a part is a simple, logical approach that is easily used by an average person with either a production-planning or tool-design background and the necessary programming training of 120 hours. When the program manuscript is completed, it is checked by another parts programmer to determine the accuracy of the program before sending it to the data-processing department (see Fig 7).

In data processing, each line on the manuscript is converted to an individual punch card by an operator using a standard IBM key punch. When all cards have been punched they are given, along with the manuscript, to another operator for verification. This consists of key punching the same information from the manuscript into a card verifier which then compares it against the punched

Fig. 7. General concept of numerical-control work flow under the WALDO system. It follows through from the time the part drawing leaves the engineering department (upper left) until the verified tape arrives at the machine tools (bottom).

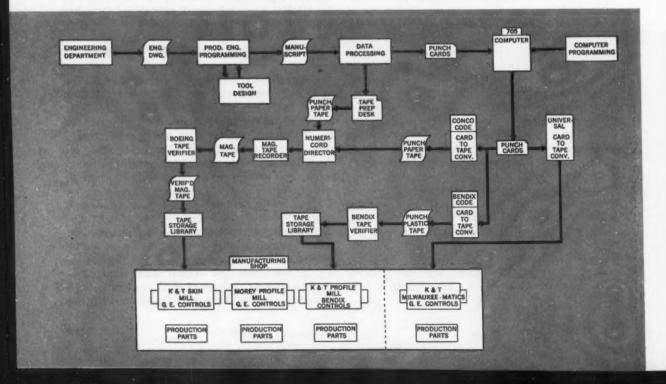


Fig. 8. This is a page from a numerical-control manuscript as written by a parts programmer. Employing a word vocabulary keyed to the WALDO system, he describes the part mathematically to suit the cutter travel desired.

card. Should an error be disclosed, an actual lockup, or stop, occurs which allows the verifier operator to determine the source of the error.

After the card deck is completely verified it is run through a listing machine which creates a printed sheet that is a replica of the original hand-written program manuscript. The deck of cards is retained by the dataprocessing department while the program manuscript, along with the key-punch listing, is returned to the original parts programmer. This allows him to compare the two lists and be assured that what he has asked for now exists as a punched card deck. It also affords him another opportunity to re-evaluate his program against the engineering drawing. When he is satisfied that the card deck is correct, a notice is sent to data processing authorizing the making of a machine-control tape.

### Computer Phase of Program

There are two IBM 705 computers available in the plant and there is always a specific amount of time reserved for numerical control. Therefore, the scheduling of a specific numerical-control computer run is a routine operation. One of the two computer consoles is shown in operation in the heading illustration.

To prepare the computer so that it will accept the input deck of cards for a specific numerical-control problem, the WALDO capabilities must first be readied within its memory and storage units. This is accomplished by transferring the

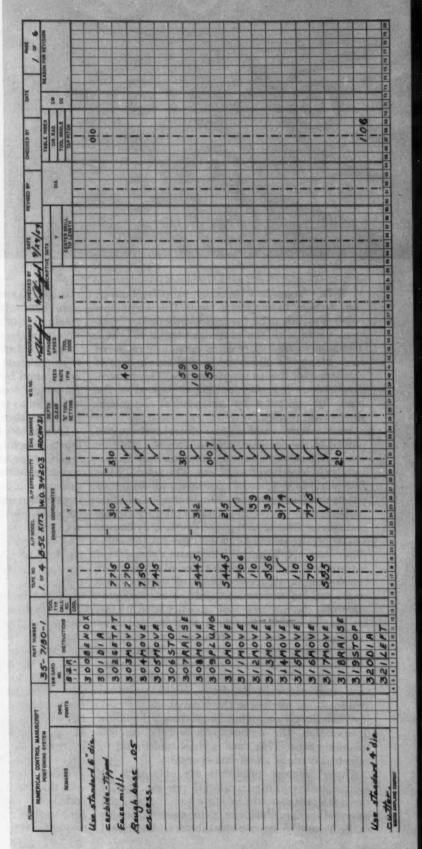




Fig. 9. "Home-made" magnetictape verification equipment. Tapes are checked out before they are turned over to the shop. In a three-way check, tape-output signals are presented graphically, visually, and audibly.

WALDO "know-how" into the computer through the medium of magnetic tape. This know-how consists mainly of all the basic mathematical solutions along with the procedure to be followed. The basic input deck of cards previously prepared from a specific numerical-control manuscript is converted off-line to magnetic tape. This conversion is done to avoid limiting the speed of the basic 705 computer by the speed of the much-slower card reader.

Since the two machine tool control systems employed in the company require only straight-line interpolation, the computer function may be distinctly divided into two phases. The result of the first phase is X, Y, and Z coordinate values for all points on the cutter center-line trace, in addition to the various feed rates called for on the program manuscript. The second phase (commonly known as the post-processing phase) converts the computer data (X, Y, and Z coordinate values) into incremental distances to be traveled for each of the three axes. All accelerations and decelerations to prevent cutter overshoot and loss of synchronization by the machine tool are calculated by the second phase of the computer program. Auxiliary function data such as coolant control and machine stops are converted to coded information acceptable to the specific machine control system on which the final tape is to be used. Feed rate, in a program for the Bendix system, is converted to a feed-rate number in the binary code.

When the computer has finished with the Phase 2 operation, the output data will be on 705 magnetic tape. This data is then transferred to punched cards in an off-line operation.

Three different print-outs are obtainable at various stages in the computing process. One of these is a cutter-center listing which contains the information describing the cutter-center locations in X, Y, and Z coordinates at each directional

change of cutter motion. An output sequence number identifies each line of this list as well as retaining the original input card (or instruction) numbers.

A second is a delta listing which contains the information to describe the incremental motions as required by the format of a particular system. An output sequence number identifies each line of this list as well as retaining the input line number (from the cutter-center listing).

Listings for the Numericord system will contain a director-time accumulation and magnetic-tape footage accumulation printed with each stop code. Machining time for the program is available through the director-time accumulation. Listings for the Bendix system will contain a machining-time accumulation and a punched-tape footage accumulation.

A converter listing is obtained when processing for the Bendix system only. It is a printed copy of the coded information punched in the output cards and the sequence identification number remains the same as on the delta listing. These listings were used to help "de-bug" the computer program during its testing and checkout period. They are now used singly and in combination to locate errors created by an incorrect entry by the parts programmer.

As previously brought out, in the second—or post-processing—phase of the computer program the first distinction is made in the computed data to make it acceptable to a specific control system. Since the two systems being used at Boeing require entirely different input formats—with reference to the Binary Coded Decimal (BCD) punched tape to the Numericord director used with the General Electric system, and the binary-coded punched tape for the Bendix system—two card-to-tape converters are in use (Fig. 7). The two converters consist of a modified IBM card

punch coupled to a tape punch, and each has been modified to create only one tape format on paper tape for the Numericord director, and on Mylar plastic tape for the Bendix system.

In these converters each output punched card from the 705 (containing the computer data) will create one block of information on the punched tape. The cards at this point make it possible for minor corrections to be made and for simple engineering changes to be incorporated by replacing one or more cards with corrected ones, without necessitating a complete new computer run.

### Continuation of Process for Magnetic Tape

When magnetic tape is the desired end item, the punched paper tape from one of the card-to-tape converters is used as input to a Numericord director. Signals from the punched tape are interpolated (digital, incremental information from punched tape is converted to coordinate analog information to control machine servo motors) and then fed into another unit where they are recorded on 1-inch-wide, fourteen-channel magnetic tape.

Verification of the magnetic tape is the next part of the tape-preparation process. The magnetic-tape verifier, Fig. 9, is completely separate from the director and operates in a manner that simulates the tape usage at the machine tool. It was built by the company's maintenance engi-

neers around a surplus General Electric control system originally intended for installation on a production machine.

Output signals, instead of guiding a machine tool, actuate a multiple-channel oscillograph, a multiple-channel oscilloscope, and an audio amplifier and speaker to provide graphic, visual, and audio checks on the content of the tape. Use of the tape verifier has reduced the time required to locate and identify trouble, supplied checks not offered by the director, provided a means for quality control of both new and used tapes, and increased production by 20 per cent through the elimination of dry-run time.

### Continuation of Process for Punched Tape

Punched tape intended for the Bendix system is also verified. This is done because the actual punching mechanism sometimes malfunctions and, therefore, would permit an incorrectly prepared tape to reach the shop.

The punched-tape verifier is, again, a special piece of equipment. It was created by modifying a card punch and attaching it to an IBM translating verifier. Following the making of a punched tape from punched cards on the card-to-tape converter, the tape is compared with the cards. When an error is encountered, the comparison process stops, allowing the operator to locate the error on the tape.

Prepared tapes can be subjected to still another, and unusual, check procedure. They can be run in conjunction with the company-designed graphic display machine, or plotter-verifier, shown in Fig. 10. Under control of a tape reader a stylus traces on paper the actual cutter paths that have been recorded on the tape. A selector switch permits the machine to plot all three views of the work-piece. The switch allows the tape instructions for any one axis to be blocked out, leaving the other two axes to be traced. By this means, every movement that the cutter on the machine tool will be directed to make-in all three axes-will be clearly outlined on paper before any metal is cut. The completed tapes are catalogued and stored in a temperature- and humidity-controlled library. From here they are checked out as required for use on the machines within the plant or sent to firms using Boeing Applied Computing Services.



Fig. 10. This prototype plotter-verifier, or graphic display machine, was also company-designed to verify three-dimensional control tapes. Its stylus will draw all three views of a part, showing the cutter-center paths for a combination of any two axes of movement.

# PRECISION FORGINGS AND EXTRUSIONS BY THE DYNAPAK PROCESS

High-level energy provided by a compressed-gas actuator enables complex metalworking operations to be performed within seconds

F. A. MONAHAN, Manager

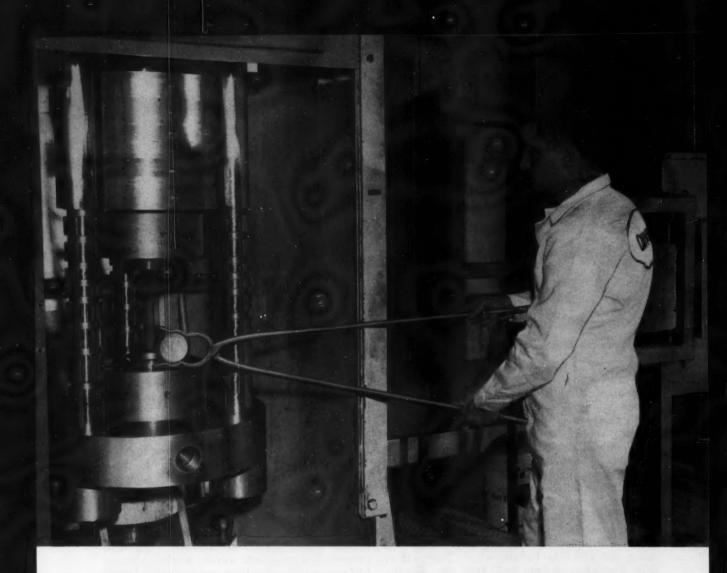
Manufacturing Development and Process Specifications
Convair Division of the General Dynamics Corporation
San Diego, Calif.

DEMANDS for ever increasing usage of superalloys and refractory metals are placing greater burdens on the designers and fabricators of advanced aircraft and space vehicles. Weight problems, which were of concern with aluminum structures, have reached a serious magnitude with the denser metal structures. Designs which require tolerances unheard of in aluminum aircraft are causing fabricators to look for new manufacturing methods to reduce difficult machining problems, save expensive material chips, and increase production capability.

In the past, forgings and extrusions were procured with large dimensional tolerances and were machined to finish size as required. Conventional forging and extrusion practices were such that close tolerances could not be economically maintained but advances in machining technology resulted in a satisfactory balance of fabricating costs. With the newer metals, however, this balance becomes unsatisfactory because the metal lost in chips is costly, and machining is extremely difficult to accomplish.

Requirements for no-draft forgings and precision extrusions with web thicknesses less than 0.050 inch caused Convair to explore the development of various high-energy-rate forming processes. As a result, Convair scientists and technicians developed a compressed-gas actuator that released high-level energy with a precision control of the acceleration-time wave form. This development resulted ultimately in the production of the Dynapak machine, which can produce accurately controlled energy up to 450,000 footpounds at velocities up to 2000 ips. It is capable of performing complex metalworking operations.

A description of this machine appeared in December, 1958, MACHINERY. The machine is based on an age-old but seldom-employed principle of pneumatics. In one chamber high-pressure gas is stored. Relatively low gas pressure in another chamber forces a piston against an orifice plate, and a seal in the piston face isolates all of the piston surface from the high-pressure gas except at the small area surrounded by the seal. As long as the high pressure acting on a



small area and the low pressure pushing against the large area (on the back of the piston) are in balance, the machine is considered "set for firing." Application of a slight additional pressure to the high-pressure chamber at the left starts the piston moving, disengaging the seal around the small hole in the orifice plate and permitting the highpressure gas to push against the entire face of the piston. This greatly overbalances the low pressure in the chamber at the right, moving the piston at velocities of as much as 2000 ips. Speed is dependent upon the size of the cylinder and the pressures employed in the two chambers. Machines can be built to develop energy levels of as much as 1,500,000 foot-pounds. The cycle is repetitive every thirty seconds with 6- and 12inch machines and once every sixty seconds with an 18-inch machine.

Extremely complex forgings and extrusions can be produced with this equipment to very close tolerances and with little or no subsequent machining required. A general view of a Dynapak model of the 12-inch size is shown in Fig. 1, while

the heading illustration shows a close-up view of another machine. Fig. 2 illustrates some of the earlier extrusions produced by the equipment for experimental purposes. Limitations of conventional extrusion practices concerning section changes, fillets, and thicknesses are overcome with this method. Precision forgings have been produced on which conventional forging limitations were overcome.

Although Dynapak is a relatively new addition to the field of metalworking equipment, the application of this process is advancing rapidly. Precise airfoil turbine blades such as shown in Fig. 3 have been successfully produced from aluminum bronze and from Type 410 stainless steel. No-draft forged flanges such as illustrated in Fig. 4 have been made from 19-9 DL high-temperature, work-hardenable superalloy with savings of 60 per cent in material, 50 per cent in tooling, and 75 per cent in machining. In addition, the structure was vastly improved with the carbides uniformly dispersed and with a forged grain size of eleven. Fig. 5 illustrates an alumi-



Fig. 1. General view of Dynapak machine which can produce accurately controlled energy up to 450,000 footpounds at velocities up to 2000 ips.

num-alloy aircraft gastight corner component precision-forged to finished dimensions. Previously this part was produced by intricate machining of a conventional forging. A comparison of the conventional versus the Dynapak-finished parts is given in the accompanying table. The saving is for the first part and additional savings would occur as repetitive parts were made following the initial setup.

The turbine fan shown in Fig. 6 was produced from SAE 4340 steel, while Fig. 7 illustrates a complex bell housing forged from the same material. The turbine wheel illustrated in Fig. 8 was forged from SAE 4130 steel. On the side opposite to that shown, this part has a thick wall section and a hub with a coarse thread. Fig. 9 shows an extremely intricate precision-forged

electronic part successfully produced from oxygen-free copper.

Since the Dynapak machine operates at rapid speed, material can be extruded at extremely high temperatures without seriously affecting the dies. For example, short lengths of tungsten have been successfully extruded with billets at a temperature of 3800 degrees F. The Dynapak process has been utilized to extrude or work many materials other than those previously mentioned, including columbium, molybdenum, cast iron, titanium, superalloys, zirconium, and uranium. Work with extrusions of composite zirconium-clad uranium fuel elements has also been accomplished. Development work is well along in producing rifled gun barrels and various components made of ceramic and glass.

	CONVENTIONAL FORGING	DYNAPAK METHOD
Weight	4 pounds 10 ounces	10 ounces
Forging	Tooling cost \$2274.00	\$3600.00
	Setup cost 198.00 Unit price 6.44	65.00 5.75
Machining	Tooling cost 7454.00	None
	Unit price 51.60	None \$3670.75

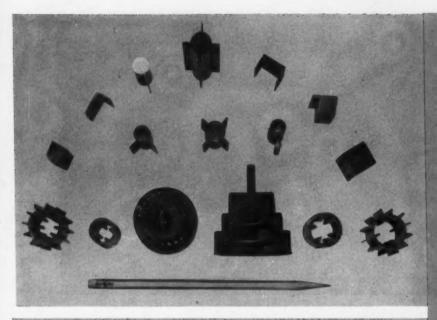
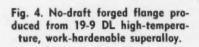


Fig. 2. Variety of early extrusions made by the Dynapak process for experimental purposes to determine the potentialities of the process.



Fig. 3. Precise airfoil turbine blades produced from aluminum bronze and Type 410 stainless steel.





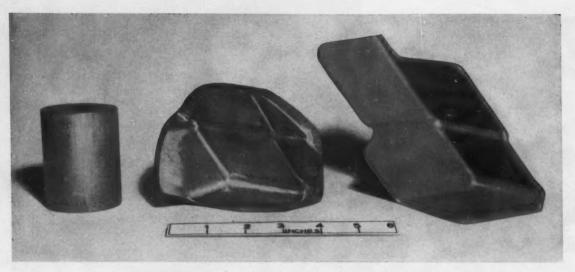


Fig. 5. Aluminum-alloy gastight corner component for aircraft application, forged to finished dimensions, thus eliminating the necessity for machining.

In view of the high velocities and high energy obtained from the Dynapak process, certain features of the tooling are different from those in tooling utilized in conventional processes. For example, the impact loading on extrusion punches is of very high magnitude. This presents a difficult problem in the selection of materials and designs for punches. At best, a compromise of desirable characteristics must be achieved. The hardness of the punch must be below Rockwell C 50 in order to take the impact and above Rockwell C 46 in order to retain the punch geometry. Vascojet 1000 heat-treated to Rockwell C 47 to



made from SAE 4340 steel.

Fig. 7. (Above) Bell housing also

Fig. 6. (Left) Turbine fan Dynapak-

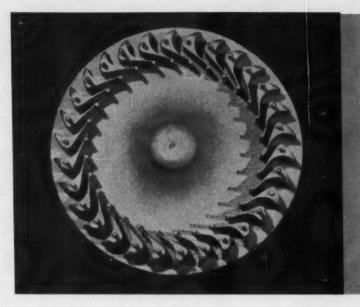


Fig. 8. (Left) Turbine wheel forged from SAE 4130 steel. This part has a hub with a coarse thread on the opposite side.

Fig. 9. (Below) Extremely intricate precision-forged electronic part made from oxygen-free copper.

49 has proved to be satisfactory, but other materials are promising.

In the design of punches for extrusion the following considerations must be observed:

1. The punch diameter must be relieved 0.015 inch on a side to reduce drag during extraction.

The area where the load is transmitted from the punch to the punch-holder must be large enough to react the loads and should have a large transition radius with the punch shank.

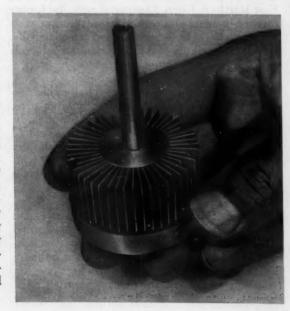
The punch must be mounted tightly against the punch-holder.

The ratio of punch length to diameter must be kept in the short column range.

The same impact problems apply to the dies. For this reason a die assembly has been utilized consisting of a die button heat-treated to Rockwell C 47 to 49, a die sleeve (or billet container) heat-treated to the same hardness level, and a massive die retainer heat-treated to Rockwell C 36 to 40. The die button and die sleeve have been made from Vascojet 1000, and the die retainer is usually fabricated from SAE 4340 steel. In one respect the extrusion dies for Dynapak are unique in that no lead-in is provided and flat bottoms and square corners are utilized. Another unique approach has been used for stripping: In this case a female thread is cut in the punch. Excess material extrudes backward into this cavity and the excess length can be unscrewed after stripping the part from the die cavity. Many extrusions have been produced successfully without lubricant, but in some cases lubrication reduces the energy required. Graphite suspended in oil and peanut oil is a suitable lubricant.

The same general conditions apply to Dynapak forging dies. These are closed dies with no provisions for flash, the excess metal being allowed to extrude through a small hole. This hole serves the dual purpose of adjusting pressure for proper die-fill and removing the excess metal.

High-energy-rate forming processes have had profound effects on metalworking practices and advanced manufacturing technology. With such methods designers have far greater freedom in the efficient utilization of materials. In addition, reliability of finished products is increased and "ideal" materials may be engineered for specific functional tasks.



# INDUCTION BRAZING SLASHES MANIFOLD-MAKING TIME

EDGAR ALTHOLZ
Associate Editor

To assemble the tubes and nozzles of its fuel manifolds, this famous jet-engine builder uncovered some amazing economies when it instituted an inertatmosphere induction-brazing process

THE LABYRINTH of nozzles and tubes comprising a jet engine's fuel manifold now is assembled by induction brazing at Pratt & Whitney Aircraft, East Hartford, Conn. Compared with the former furnace-brazing procedure, manufacturing costs and cycle times have been slashed phenomenally. Of equal significance, the induction-brazed joints are metallurgically superior because the work is heated for only a few minutes.

Each manifold consists of two half-circles, located just forward of the engine's burner cans. There are eight such cans, arranged annularly. Fuel is directed through the tubes of the manifold to a cluster of nozzles (six nozzles per cluster) which atomize it in front of each can. Each half-circle thus has four clusters. One of the clusters is shown being inspected in Fig. 1 before it is assembled to form a half-circle.

Actually, the tubes connecting the clusters and nozzle bodies are coaxial, there being a second tube system of smaller diameter within, and concentric to, the visible system. Under ordinary flight conditions, fuel is fed only through one system. When reserve thrust is needed, fuel is fed through both systems. Tubes connecting the

clusters are Inconel; nozzle tubes and forgings are 347 stainless steel, an austenitic alloy not hardenable by conventional heat-treatment.

The braze metal is a preformed ring of wire. Various ring sizes are required, to suit the different tube and fitting diameters involved. Copper rings are used for the cluster sub-assemblies; goldnickel alloy rings, for the coaxial intercluster connecting tubes. In Fig. 2, the technician is preparing a cluster for brazing by placing a ring in one of the counterbored diameters of a nozzle forging. A tube is then inserted.

The now obsolete furnace-brazing procedure required the use of a chrome-iron fixture, shown being loaded in Fig. 3. To meet production schedules, a large number of these fixtures had to be in continuous service. Each fixture accommodated a complete manifold—two half-circles—of connecting tubes and clusters. The furnace cycle consumed thirty hours. In addition, it took many extra hours for the fixture to cool off before it could be handled.

Each fixture was heavy (over 1500 pounds) and costly (\$4300). In addition—and this by far was the most serious objection—the brazing tempera-



ture of 2050 degrees F. distorted the fixtures, so that they had to be reworked for each furnace cycle. This added another \$1000 to the cost of each cycle, and kept a six-man crew of machinists busy practically continuously.

### **Furnace Fixtures Perishable and Costly**

After a fixture had been reworked about twenty times, it had to be scrapped, since it no longer possessed sufficient structural mass to hold the manifold configuration within required tolerances at the brazing temperature. Thus, for each twenty-one manifolds brazed, tooling costs ran as follows:

Initial fixture cost	\$ 4,300
Cost of twenty reworkings	20,000
Fixture cost, per useful life	\$24,300

When it is realized that a considerable number of fixtures was involved, the tooling figures were astronomical. What is more, maintaining the brazing furnace itself represented a big expense. A new retort was needed after every twenty-five

loadings. Too, the furnace required periodic rebricking.

The present induction-brazing method, a brain child of P&W A's Production Engineering Department, replaces the thirty-hour furnace time with two heating cycles (one for the cluster subassemblies and one for the half-circles) that last just a few minutes. The heavy, high-cost, highly perishable iron fixtures have given way to light, permanent, aluminum ones. All assembling and brazing activity is carried out in an air-conditioned area. Cleanliness is assured by electrostatic dust precipitators which are part of the air-conditioning system.

Because the cycles are rapid, there is less intergranular alloying of the braze metal, so joints are stronger. What is more, should the wire braze ring inadvertently be omitted from a joint, the correction can be made locally. Formerly, the entire manifold had to be returned to the furnace for recycling, and there was always the risk of weakening the good joints, which necessarily had to be reheated at the same time.

Cluster sub-assemblies for the J-57 and JT-3 engine manifolds are brazed in the cabinet seen



Fig. 1. The brazed joints of the cluster's coaxial tubes and nozzle bodies get a careful inspection. Eight of these clusters comprise the jet engine's manifold system.

in Fig. 4. It has four sections, permitting four different clusters to be processed at the same time. Actual work area is within a hood, or chamber, atop each section. The chambers are water-cooled, and are brass castings, since they are in the field of the coils and must necessarily be non-magnetic. Covers on the chambers, being outside the fields, are made of steel. Portholes in the front wall of the chambers permit the work to be observed during the brazing—something that was impossible to do in the furnace.

In Fig. 5, one of the chambers has been raised for loading. After a cluster is properly nested in the fixture, coils are swung over each of the joints. These coils are of two-piece design, to completely surround the joints when in position. Mating surfaces are bored out to form a field around the work. The copper coil bodies are hollow and with connecting hoses form a circulating water system. A feature of the fixturing is the provision for permitting the nozzle bodies to float so that the tubes

After the fixture is loaded, the chamber is lowered over guide pins, and its flange is secured to the table top with quick-acting clamps. By en-

will fit properly as they are expanded by the heat.

Fig. 2. A ring of braze metal is positioned in the nozzle body before the tubes are assembled. Rings are made in a variety of sizes according to P&WA specifications.



Fig. 3. This fixture, used in now obsolete furnace-brazing procedure, had to be reworked after each cycle because of the heat.



ergizing a start button, the chamber then is purged with a mixture of 97.5 per cent argon and 2.5 per cent hydrogen. Simultaneously, the cluster is also purged internally. This purging excludes all air and provides a dry atmosphere (-70 degrees F. dew point).

Blending of the two gases is done outside the brazing area and the gas ratios are maintained automatically by a monitoring system. Purging

takes three to five minutes.

Once all air is excluded from the chamber, current flows through the coils. Heat is applied "softly," and is built up over several minutes to

2050 degrees F., ±25 degrees, at a frequency of 9600 cycles per second. (Most induction-heating applications involve higher frequencies, and temperatures are built up in a matter of seconds. The conservative approach employed here, however, avoids any likelihood of over- or underheating.)

Gas pressure is maintained during the brazing. After the brazing, the gas serves to accelerate the cooling of the work. Visible in Fig. 4 to the side of the cabinet is a control panel by which the entire procedure is programmed. Interlocks protect the operator, the parts, and the equipment. Production is virtually continuous, since the unloading

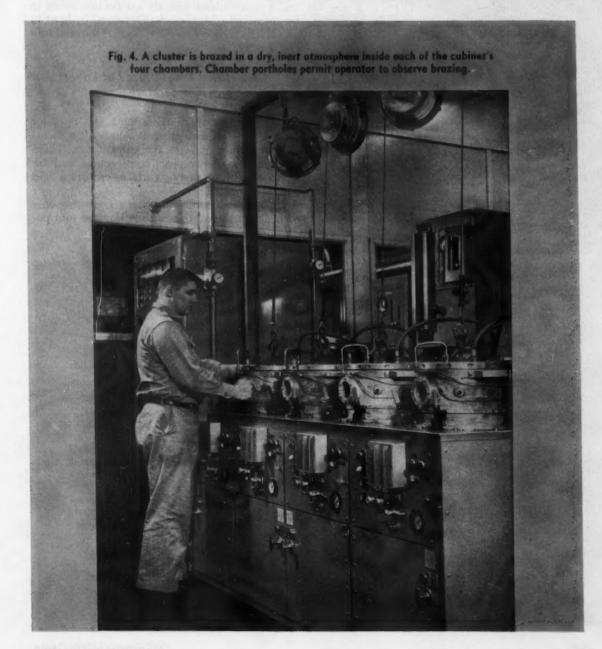




Fig. 5. Close-up view of cabinet section (chamber off) shows coil and fixture design. After cluster is nested, half of each coil is swung over each joint to be brazed.

and reloading at any one of the sections of the cabinet takes place while the other three sections are cycling.

Completed sub-assemblies undergo a pressure test, then are returned to the bench, where the gold-nickel braze rings are inserted in the fittings for the coaxial connecting tubes. Four clusters are next positioned around an aluminum fixture plate and are assembled with the connecting tubes to form a manifold half-circle. Conveyed by hoist to another brazing cabinet, the plate is lowered into position, Fig. 6.

### Gold-Nickel Rings Brazed at Lower Temperature

The heading illustration shows the operator closing the coils over the tube joints after securing the fixture plate to the cabinet top. These coils are also of two-piece construction, and are hollowed on their mating surfaces to form a field around the joints.

The large aluminum chamber seen resting on a shelf above the cabinet is then lowered into po-

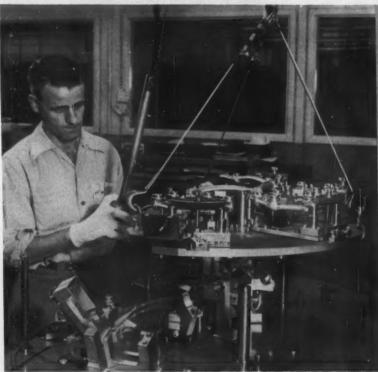


Fig. 6. Each manifold half-circle is assembled on a fixture plate which then is positioned on a brazing cabinet. Meanwhile, the next half-circle is assembled on another fixture plate.

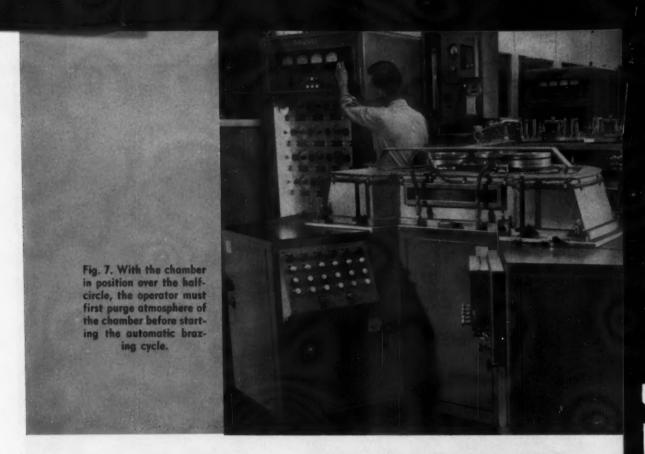


Fig. 8. Leaky joints are quickly detected in manifold half-circle bubble test. Plugs in nozzles seal off apertures during the test.

sition and clamped down. Purging and brazing follow a procedure similar to that detailed for the clusters, except that the gold-nickel rings are brazed at a somewhat lower temperature (1850 degrees F.) than are the copper rings used in the cluster sub-assemblies. Here too, the clusters are permitted to float in their nests, to compensate for the expansion of the connecting tubes when heated.

In Fig. 7, the operator is seen at the control panel. The equipment permits individual station control of the heat input. By adjusting timers and potentiometers, heat can be applied at four different intensities for each half-circle. In this way, temperatures can be selected for the preheating and cooling phases of the cycle as well as for the brazing itself. Several identical fixture plates are kept in work, so that the unloading and reloading of each can proceed without idling the brazing equipment.

Every completed half-circle goes through an underwater pressure test, Fig. 8, to detect any leaky joints which may have been caused by a missing braze ring. Plugs are temporarily placed in the nozzles to seal off the apertures. Then air is forced through tubes at a pressure of 90 psi. Any bubbling pinpoints a poor joint.



Fig. 1. (Right) Designed within the company, this four-station per cent-line saw is doing an effective job of contouring honeycomb panels for the B-58 Hustler. Track-mounted carriage positions a large swinging band-saw boom in front of each station in its turn. Honeycomb cores are held in ice platens.





### E. W. FEDDERSEN Chief, Manufacturing Research and

Development, Convair Division
General Dynamics Corporation
Fort Worth, Tex.

Convair-Fort Worth is the home of the
B-58 Hustler, a strategic bomber-reconnaissance
weapon system. To build this twice-thespeed-of-sound aircraft some unusual equipment
is being used. There is a five-axis template
mill, the only one of its kind in existence. A
four-station, per cent-line saw using ice chucks
was built within the company to
fulfill the specific needs of Hustler
components. Not to be overlooked is a large
sheet-metal forming machine—the only
one in this country—that works the
material by a process of differential stretching

THERE IS VERY LITTLE that can be called traditional about the B-58 Hustler. With a length of only 97 feet and a wing span of only 57 feet—yet powered by four J-79, 15,000-pound-thrust jet engines—this Mach 2 intercontinental (with mid-air refueling) Air Force bomber reverses the trend toward larger and larger strategic aircraft. It is designed around a minimum-size concept, packing maximum mission performance and flexibility into minimum weight and space.

An important part of this minimum-size concept is a disposable armament pod carried beneath the B-58's fuselage. Pods can be used to carry a destructive payload, additional fuel, aerial cameras, or electronic countermeasures. This appendage eliminates the necessity of hauling needless empty space within the aircraft once the bombs have been dropped or the fuel has been used. Convair is currently producing sixty-six of these delta-wing aircraft at its Fort Worth facility, with at least twenty more to follow.



Fig. 2. With the back end of the saw boom (A) pivoting on a half-gimbal joint (E), the front end rises and falls during the feed movement as dictated by cam track

(C). Directed by a second set of follower rollers, hydraulic cylinders (F) tilt the boom in order to keep the saw blade tangent to the work contour at all times.

# TOOLING FOR MACH 2 HUSTLER

### Four-Station Airfoil Honeycomb Saw Guided by Cam Tracks

Not only is the Hustler unconventional in speed, size, and in techniques of accomplishing varied missions, but also in many production methods dictated by its advanced design. One of these makes use of an airfoil honeycomb saw, also called a per cent-line saw. It is a recent, company-designed installation that consists of a moving, track-mounted saw carriage and four pie-shaped work stations, as can be seen in Fig. 1.

Although the saw carriage rides along steel tracks, propulsion is derived from powered rubber wheels beneath the carriage that grip the concrete floor of the shop. Accurate positioning of the carriage at each work-station is of great importance because the pivot point of the cantilever saw boom A, Fig. 2, must be in exact alignment with the vertex of the segment-shaped

tables. Trip-dogs along the tracks stop the traversing movement of the carriage at each station, after which two bullet-nose locating pins move out hydraulically from the carriage base and engage holes in floor-mounted fittings at the front and rear (one fitting is shown at B). One safety precaution: the boom must be completely raised to clear the work area before the carriage can be advanced.

In reality, the boom is a giant band saw having an unsupported span of 8 1/2 feet between saw guides. A 10-hp motor drives the blade—which is 1 inch wide with 14 teeth per inch—at a speed of 10,000 fpm. Carbon steel is used as the blade material because of its flexibility: high-speed steel proved too rigid for this particular use.

As can be imagined, with a free length as great as this there is a considerable tendency for the blade to sag. Obviously, for reasons of accuracy, such a condition could not be tolerated. To maintain a catenary of less than 0.003 inch over the



Fig. 3. Two different honeycomb panels can be worked in one setup, each panel requiring the use of two work

stations. When contouring the first surface, as shown, the core rests on a flat surface on the ice platen.

8 1/2-foot span the blade is constantly under a longitudinal tension of 2000 psi. The tension is applied by a hydraulic cylinder that pushes out against the tracking wheel in the boom head.

Should the blade break, the hydraulic piston and tracking wheel advance instantly toward the head and trip a limit switch. This actuates a hydraulic valve that applies braking pressure to lock the driving and tracking wheels and also trap the blade.

Both wheels are 26 inches in diameter, flanged on the backside, and tapered toward the front face. Due to this configuration the back edge of the blade tends to rest against the flange at all times, thus providing positive location of the tooth line. Also, the width of the wheels is such that the tooth set of the blade rides clear of them.

Each of the four work stations encompasses an arc of 77 degrees. Extending along the curved outer edge of each table, and parallel to it, are two contoured members—a cam track C, Fig. 2, and a sprocket-chain track D. A follower roller on the head of the boom rides along the top surface of the cam track, thereby causing the outer end of the boom to rise and fall as prescribed.

Boom movement in an up and down direction takes the form of a pivoting motion, its back end being suspended from the carriage by a half-gimbal mounting arrangement E. A rotating sprocket wheel on the boom head engages the sprocket-wheel track to provide the feeding movement. Usually, two different honeycomb panels are set up at the same time on the four work-tables, two tables being used for each panel. The panels, as they arrive at the machine, are flat on both faces and the first of each pair of platens is accordingly flat-surfaced.

Precise location of the fixture with respect to the table and saw boom is very important in per cent-line contouring. This is assured here by a pin that extends from the vertex of the table top and passes through an appropriate locating hole in the platen, or fixture. The distance from the vertex pin to the cam track is 157 inches.

After the boom has swept past the work-table and has cut the desired contour in the top surface (Fig. 3), the panels are removed, flipped over, and placed on the second platen of the pair. The supporting surface of the second fixture of the pair is shaped to conform to the panel face just cut. Thus positioned, another sweep of the boom will contour the reverse face to complete the panel. The same two-step operation takes place at the other two work stations on a different panel, with the saw carriage traveling to, and locking in position at, each of the four stations in turn. Pivoting cycles of the boom can be set to require 3, 5, 7, 9, or 11 minutes at each station.

A feature of this machine is its provision for keeping the flat surface of the saw blade tangent to the contour being cut. There is a pair of tandem rollers directly behind the main follower roller in the head of the boom; these rollers also ride on the cam track. As the main follower roller rises or falls along the cam surface, the tandem rollers sense the change in relative height between them. This actuates a sensitive valve that controls fluid flow to two hydraulic gimbal tilt cylinders (F, Fig. 2) which, in turn, realign the boom with relation to the work surface.

Platens used on this installation are, in reality, ice chucks. When the honeycomb panel has been positioned on the platen, water is sprayed over it in a fine mist until the cells are filled to a depth

of 1/16 to 1/8 inch. Then, to assure proper contact between the bottom of the core and the platen during freezing, 5-pound bags of Kirksite shot are distributed over the top of the core.

All four platens are manifolded to a single refrigeration unit that was designed and built by Almar York Corporation. (The unit can be seen at the rear of the saw carriage in Fig. 1.) Electropneumatic valves at each work station, under the operator's control, signal for either refrigeration or heat, as required, for the individual platens.

Ethylene glycol is the refrigerant used in this system. Not only is it used to cool the platens to a temperature of 5 to 12 degrees F., but also to defrost them. This is done by means of a "hot tank" in which an electric heating element maintains ethylene glycol at a temperature of 180 degrees F. Both the hot and cold liquids are pumped under a pressure of 20 psi.

The entire operation requires, at its longest, 23 minutes. Only 3 to 5 minutes are needed for the freezing cycle and a maximum of 11 minutes for the cutting cycle. During defrosting, which requires from 5 to 7 minutes, the platen is brought to a temperature no higher than 40 degrees F. This temperature is high enough to release the honeycomb panels in the time given, yet low enough to avoid overloading the refrigeration unit.

At present, this installation is being used for rough sawing only. During roughing, approximately 0.030 inch of material is left on each side of the panel. The surfaces are then finished to

size by crush die forming. In the future the honeycomb panels will be sawed to finished dimensions within a tolerance of plus or minus 0.003 inch, although the machine is capable of holding a total tolerance of 0.003 inch. All that is needed is to install precision contour cams.

### Template-Controlled Mill Cuts Along Five Axes

An unusual machine, and the only one of its kind in existence, is the five-axis contour-milling machine shown in Fig. 4. It is capable of 360-degree profiling movement, cross tilt, longitudinal tilt, and axial depth movement, all controlled by templates. All of these movements can be controlled individually, simultaneously, or in any combination.

Development of this machine was the result of an Air Force contract with the Lockheed Aircraft Corporation several years ago. Through a subcontract it was constructed by the Cincinnati Milling Machine Co. Basic intent of the machine was to take light finishing cuts on aluminum forgings. The B-58, however, has few forgings and so most work is being done on extrusions and solid plate stock.

This is by no means a small machine. It is capable of handling parts up to 48 inches wide and 228 inches long (with a 4-inch-diameter cutter) on a stationary work-table having the same measurements. Movements of the cutter—which is supported in a rail-mounted traveling bridge—

Fig. 4. A one-of-a-kind installation is this five-axis, template-controlled contour-milling machine. Templates are carried on the three tiered tables at the right. A rail-mounted traveling bridge at the left carries the spindle head along the full length of the 48-by 228-inch stationary work-table.

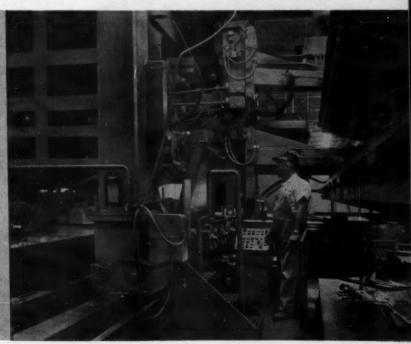




Fig. 5. Here, three electrohydraulic tracer arms can be seen extending over the three template tables. Lower table (G) controls 360-degree, three-dimensional traveling of the cutter. Middle table (H) controls cross swivel, or tilt, of the cutter, while the upper table (J) takes care of the cutter's longitudinal swivel.

are controlled by pilots, operated by templates, that guide it through the various positions required around the work-piece.

To the right of the mill are three tiered template tables, Fig. 5, that extend the full length of the machine table. Suitable tapped and locating-pin holes are provided for template holding. Three long support arms, one for each tracing valve, extend from a tall upright column to the template tables.

Templates on the first, or lower, table G work in conjunction with a 360-degree, three-dimensional automatic profiling unit that controls three of the five axes of movement. It traces the template in lateral and longitudinal directions, in addition to sensing changes in depth. Tooling mounted on the second, or middle, table H controls the cross swivel (tilt) of the cutter. Similarly, templates on the third, or upper, table I direct the longitudinal swivel (tilt) of the cutter.

On the upper two tables tracing is done in an up-and-down direction only, therefore less complicated, automatic depth-control valves carry these styluses. (The styluses bear on the templates with a pressure of 2 ounces.) Templates used on both these tables are designed on the basis of 1 degree of twist being imparted to the cutter for every 0.060-inch rise or fall of the stylus.

Either of two heads can be used on this contour mill. A high-speed head provides 20 hp at 3600 rpm and 40 hp at 7200 rpm. A low-speed head, on the other hand, provides speeds ranging from 40 to 1800 rpm in twelve steps and is capable of transmitting 1/4 hp per rpm up to a maximum of 48 hp.

Work area and spindle head are shown in Fig. 6. The head is supported in a trunnion arrangement which allows a free movement along two axes. It is carried on a trunnion cradle K which is pivoted at both ends, thereby providing the desired cross-swiveling motion. Longitudinal swiveling is done within the cradle itself, the head being able to swing to the left and to the right on circular ways L.

A flood coolant system is used to control the large quantities of chips removed by the high-

Fig. 6. Work area of the five-axis contour-milling machine. The head swivels longitudinally along curved ways (L). These ways are, in turn, mounted on trunnion cradle (K) which is pivoted at both ends to permit swiveling motion in a transverse direction.

Fig. 7. Several dials are provided to keep the operator informed as to the position of the spindle and its direction of travel. Dial (N) indicates longitudinal swivel up to 45 degrees in either direction. Transverse swivel, 20 degrees either side of center, is shown on dial (O). The third dial (P) indicates direction of cutter movement.

speed cutter. Soluble oil and water are pumped through a large-diameter hose to a discharge ring M at the rate of 250 gpm. This high volume of coolant completely surrounds the spindle and effectively prevents the chips from escaping through the liquid curtain. Instead of flying in all directions, they are tamely washed away from the cutting area and flushed into troughs on each side of the machine table.

In addition to the necessary controls at the operator's station, Fig. 7, several dials are furnished to inform the operator of the spindle's position and travel. Longitudinal swivel is indicated on the dial at N which reads its full tilt of 45 degrees in either direction. Likewise, transverse, or cross swivel is noted on the dial at O which reads a swing of 20 degrees either side of center. A third dial P indicates the direction of cutter travel—right, left, front, rear—and is graduated in degrees of a full circle.

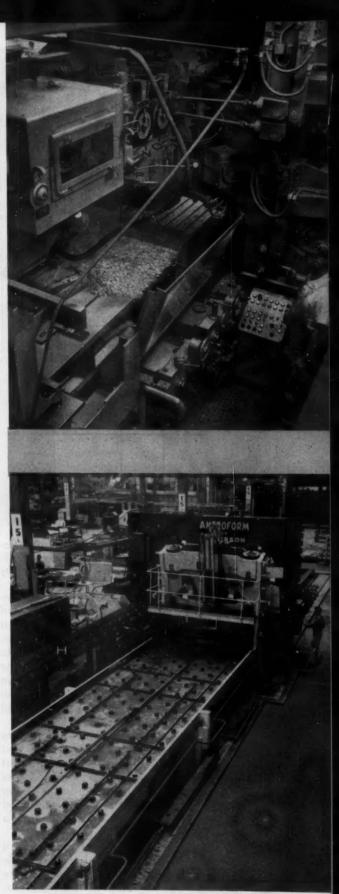
Due to the double tilt of the spindle assembly, a built-in feature of the machine provides automatic correction of the cutter position when changing from a circle to an ellipse on the plane of action. The correction unit changes the position of the three-axis tracer finger in two planes of action when a two-directional tilt is affected. It allows the two tilt axes of the spindle to remain respectively parallel with the work contour at the point of cutter contact. The unit also corrects cutter height to compensate for the change in elevation of the cutter due to the angle of tilt.

### Skin Panels Formed by Dieless Drawing

Contoured surfaces for several of the skin panels used on the Hustler can be formed without conventional dies by an unusual technique called the Androform process. The Androform machine at Convair is the only one installed in this country, several being used in Europe. A view from the loading end, showing the feed table, can be seen in Fig. 8.

What it Does—Simple as well as compound shallow curved surfaces can be produced by this means. Limitations as to the depth of draw are

Fig. 8. Loading end of machine used for dieless drawing of Hustler skin panels. Sheet-metal blanks roll along feed table (foreground) and enter the first stage of the machine where a restraining force is applied by beaded elements. Adjustable control cams are at (H).



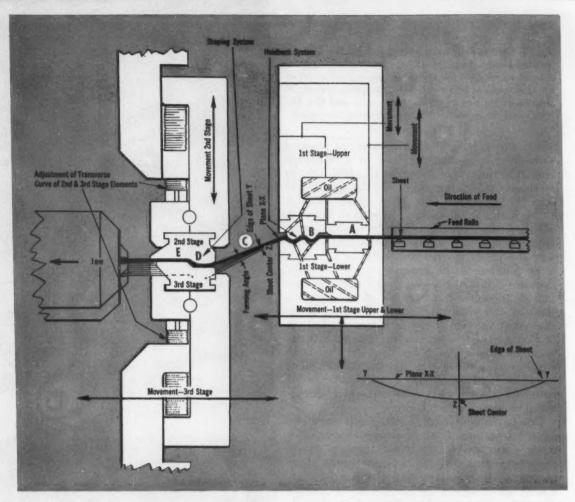


Fig. 9. Cross section through the work area of Androform machine. Beaded first-stage forming elements (B) apply tension to the metal as it is pulled through by

gripper jaws (left). Flexible forming elements at Stages 2 and 3 are adjusted to desired transverse contour, while angle at (C) determines longitudinal contour.

dictated by the gage and properties of the material being formed. Generally, maximum depth of draw will be a spherical radius of from one and one-half to two and one-half times the sheet width. Maximum transverse contour is limited to two and one-half times the sheet width when the longitudinal curvature is shallow. Sheet stock can be formed at room temperature from such materials as titanium, stainless steel, aluminum, and magnesium, even in a heat-treated condition.

In this process the sheet metal is formed into compound curvatures in much the same way that a narrow strip of paper is curled by pulling it between one's thumb and forefinger. The paper forms because it is stretched more in the center than at the edges. Similarly, a metal sheet formed on the Androform machine is stretched to a greater degree in some areas than in others.

Technically speaking, the metal undergoes a controlled flow in predetermined regions while being subjected to bending stresses that are superimposed on tensile loading. In this manner,

varying strains of a predetermined magnitude and direction are set up throughout the area and thickness of the blank in a continuous flow which results in blended plastic deformation. Thus, blanks that are either rectangular or truncated, and of either constant thickness or tapered, can be transformed into compound curves of either simple or intricate shapes.

How it is Done—Illustrated in Fig. 9 is a simplified cross section of the Androform work area showing a sheet-metal blank in the process of being formed. There are three forming stages that act on the work. The first stage has an upper and lower member carrying two rigid forming elements. These elements consist of a series of beads (straight in a transverse direction) for holding the sheet metal in tension. This stage can move left or right, up or down (see arrows).

Two other forming elements, Stages 2 and 3, are flexible so that they can be adjusted and locked in any number of contours. Contours of each of these stages are altered by a row of from

twenty-six to fifty jack-screws. Stage 2 can move vertically, while Stage 3 can move horizontally.

Initially, with all stages open, the material to be shaped is guided from the feed rails (right) and through the three stages. The second stage is then partially closed to flex the leading portion of the sheet downward so that it can be engaged with a row of twenty gripper jaws, the jaws having previously been adjusted to match the curvature of the second- and third-stage elements.

With the sheet-metal blank in place, the first and second stages close to predetermined gap settings and the jaw carriage (which backs away from the work area on rails) is activated. The jaw carriage is indicated at F in Fig. 10, showing the unloading end of the machine. Pressure plates A (first stage) prevent buckling of the sheet and also act as oiling plates. Forming elements at B restrain the material and thereby place the blank under a tensile load. Transverse surfaces of A and B lie on plane X-X in the Fig. 9 projection.

Work material then passes through the second and third stage elements at *D* and *E*. These elements are curved transversely as indicated by the curved line Y-Y in the projection. The contour to which these elements are adjusted at the time of setup (by means of the jack-screws) is a computed proportion of the variable transverse contour required in the finished panel. It does not

change during the forming cycle.

As the material passes from C through D it is passing from a surface on plane X-X to a curved surface Y-Y. This causes the material to elongate in small increments, and only where required. Elongation is maximum at the deepest part of the contour and becomes progressively less leading up to the edges of the blank where no elongation occurs. In this way, both transverse and longitudinal curvatures are set into the blank. The ironing action at E prevents buckling, oil canning, depressions, Luders lines, and orange-peel effects in the formed panel and assures a smooth aerodynamic contour.

Producing Varying Curves—When set up and operated as described, the panel produced would have a constant curvature in both directions. Unfortunately, this seldom meets the requirements of the aircraft and missile industry—panels with varying curves must be produced.

To do this, movement of the three stages must be brought into play. As the first stage is brought closer to the second and third stages the forming

angle is increased, causing greater elongation of the material and, therefore, greater curvature. Movement away from the second and third stages, on the other hand, decreases the forming angle and, likewise the curvature.

Horizontal movement of the third stage controls the longitudinal presentation of the formed panel. Closing the gap in which the material is formed between D and E will cause the panel to curve downward, while opening the gap will cause it to curl upward. This is a control of the presentation of the blank in space only—the true map of the surface is generated by the previous forming actions. Adjustment of the third stage can be made, for example, so as to present a panel as a coil which, when unrolled and help on a plane surface at the four corners, will reveal the true compound contour formed into it.

Lateral movement of the first and third stages is hydraulically controlled by tracer valves at G, Fig. 10, that ride along cam ribbons. These flexible cam ribbons are properly set by means of

adjusting screws at time of setup.

There are six cam assemblies (shown at H in Figs. 8 and 10) which are attached to, and travel with the jaw carriage. They control such functions as simultaneously moving the upper and lower first-stage elements toward, or away from, the other two stages; moving the third stage laterally; controlling the closure rate of the first and second stages; and tilting the first stage either left or right.

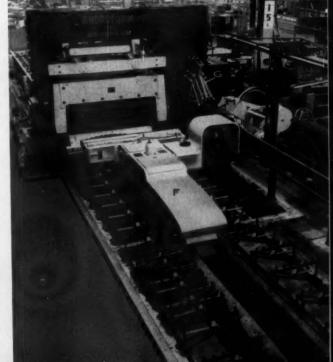


Fig. 10. Opposite end of installation shown in Fig. 8. When the machine is in operation, blanks are gripped by a row of jaws and pulled between contoured forming elements as jaw carriage (F) backs away. Operation is controlled by six cam assemblies at (H).



Ryan Aeronautical Co. spot-welds paper-thin steel strip into chambers capable of withstanding pressures over 300,000 pounds per square inch

GUIDED-MISSILE test chambers as large as 54 inches in diameter have been fabricated from stainless-steel strip only 0.008 inch in thickness by 18 inches in width. These test chambers have withstood hoop stresses of 300,000 psi. They were produced by the Ryan Wrap process developed in the research laboratory of the Ryan Aeronautical Co., San Diego, Calif.

To form the 54-inch test chambers, eight layers of the stainless-steel strip are spirally wound on top of each other in the machine shown in Fig. 1. The strip is wound around a huge copper drum or mandrel of the required diameter and length to suit the dimensions of the rocket chamber. Before the operation is started, a forged ring of 17-7PH stainless steel is mounted on each end of the mandrel to provide flanged ends for the rocket chamber. The strip material is spotwelded to these rings while on the winding machine, as illustrated in Figs. 2 and 3.

Mounted on an overhead rail of the winding machine is a spot-welding head used not only to weld the strip material to the end rings, but also to make a multiplicity of spot welds around the outer joints of the strip metal to securely bind the

eight layers of strip together.

# SUPERSTRENGTH ROCKET CHAMBERS MADE FROM PAPER-THIN STEEL

CHARLES O. HERB. Editor

The strip material is welded on each side of the joints and completely around the chamber. Obviously, on a 54-inch diameter chamber, several thousand spot welds must be made. Indexing for spot welding occurs automatically on the large machine and two spot welds are made simultaneously.

In Fig. 4 is shown a view of a smaller stripwinding machine equipped with a mandrel for fabricating 14-inch diameter chambers. With this equipment, the strip material is tack-welded in

place and then the chamber is removed from the mandrel and transferred to the spot-welding machine in Fig. 5 for making the multiplicity of spot welds around the part.

In this welding, use is made of a simple Fiberglas positioner or jig. This positioner has several rows of half-holes into which the welding-head electrode can be successively guided with ease. Alternate rows have the half-holes staggered and they are located on 3/8-inch center distances.

Extensive research was conducted before a

Fig. 1. Wrapping stainless steel only a few thousandths of an inch in thickness around a large copper drum to form rocket chambers 54 inches in diameter.





Fig. 2. As the successive layers of stainless-steel strip are wound on the drum they are spot-welded together by two welding heads that are operated as one unit.

decision could be reached as to which fabricating material would meet all the conditions to be found in the construction of the rocket chambers. Conclusions reached are that AM 355 cold-rolled (70 per cent reduced) and AM 355 cold-rolled and tempered are the most satisfactory at the present time. In experiments, as many as twenty layers of stainless-steel strip were successfully welded.

Ryan carried on an extensive search for a material that would meet all the conditions to be found in the construction of these chambers. Metals tested included 17-7PH stainless steel, 301 extra full hard, AM355 subzero cooled cold-rolled and tempered stainless (in both the 30 per cent and 70 per cent cold-reduced types), PH15-7Mo, HE-25, AM355 cold-rolled and tempered, and AM355 cold-rolled and tempered extra-hard.

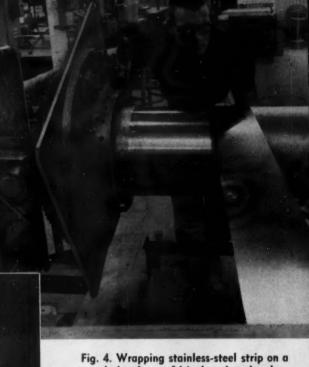
Two-ply spot-welded specimens were made from each of the alloys investigated. Specimens ranged in width from 0.300 to 0.750 inch and the number of spot welds varied from one at the center of the strip to overlapping welds across the entire width.

Testing included determination of parent metal yield and ultimate strength, Young's modulus and per cent of elongation, ultimate strength reduction due to spot welding, and a strengthto-weight comparison, which was determined by dividing the ultimate strength by the material density.

It was found that these tensile tests, by themselves, were

Fig. 3. Close-up view of double welding head employed in fabricating the 54-inch rocket chambers.

not enough to warrant elimination of any one of the metals. A tear test of the various materials was then made. There is a correlation between the type tear, the tearing force, and the ability to predict ultimate load on a laminated structure. A straight-line tear rather than a jagged line, plus a high tearing force, are desirable qualities. This test also proved inconclu-sive, since all the alloys tested tore in a straight line, and all of them required approximately



mandrel to form a 14-inch rocket chamber.

Fig. 5. In spot-welding 14-inch chambers a Fiberglas jig is used for correct spacing.

Fig. 6. Inspecting wrapped rocket chambers adjacent to the spot-welding machine.

the same amount of tear force.

The next test was a drop-ball impact test designed to measure the relative brittleness of the metals, and to obtain an idea of their relative ductility. Each alloy was tested to the fracture point. It was found that AM355 sub-zero cold-rolled and tempered (30 per cent cold-reduced) alloy absorbed the greatest amount of energy prior to failure.

MACHINERY, June, 1960

177



# BIG STAINLESS-STEEL SLABS MACHINED FOR FLEXING IN SUPER WIND TUNNEL

The newest Air Force Research Center uses special stainless alloys in a construction program that enables future flight conditions and speeds in space to be simulated on the ground

MILTON KARR, Assistant Chief Engineer Consolidated Western Steel Division United States Steel Corporation Los Angeles, Calif.

THE ARNOLD Engineering Development Center in eastern Tennessee is a place of spaceage extremes—a \$300,000,000 engineering and development center where aircraft, missiles, and space weapons are tested at speeds up to twenty times the velocity of sound at altitudes above 200,000 feet, through temperatures from 120 below zero F. to 15,000 above.

But this is no hypersonic air show. The "flights" are only simulated and are performed without leaving the ground. This is a testing center in which a variety of performance and torture type studies can be conducted on whole aerospace vehicles, models, missile sections, and full-sized power plants. United States Steel's Consolidated Western Steel Division has completed its part in helping to design and build this world of tomorrow's air vehicles and their prime movers.

This project is made possible by the Arnold Engineering Development Center's aeronautical and propulsion testing laboratories which are part of the United States Air Force's Air Research and Development Command. These are the most advanced facilities of their kind in the Free World. The project began when the end of World War II revealed the startling accomplishments made by the Germans in aeronautical research and development. Immediate steps were taken to formulate a plan for the future qualitative superiority of American airpower. Named for the late General Hap Arnold, Commanding General of the Army Air Forces in World War II, the AEDC is the materialization of this plan.

The bulk of the Center's facilities falls into three main divisions: the Gas Dynamics Facility.

called "GDF," the Engine Test Facility, called "ETF," its Ramjet Addition, and the Propulsion Wind Tunnel, called "PWT." Consolidated Western Steel was a prime contractor on the GDF and on a large part of the ETF. Additionally, this division of United States Steel completed (on a joint-venture contract) the design, procurement, manufacture, and construction of the first half of the Plenum Evacuation System, a major engineering feature of the PWT.

The Gas Dynamics Facility consists of several supersonic, hypersonic, and hypervelocity wind tunnels in which air speeds from 1000 to 15,000 mph are generated. Models of supersonic aircraft, missiles, and spacecraft are tested under highly realistic flight conditions. The tests are aerodynamic and consist essentially of measurements of forces, pressures, and temperatures which result from high-speed flight in the lower and upper layers of the atmosphere. The wind tunnels are of the continuous-flow and intermittent-flow types.

The GDF continuous-flow, supersonic tunnel has a test section 40 inches square and operates over a Mach number range from 1.5 to 6. Called "Tunnel A," it was designed and fabricated by Consolidated Western at its two Los Angeles plants and shipped to Tennessee for erection by the same firm. Tunnel B-2 is a continuous-flow, hypersonic tunnel equipped with a fixed, Mach No. 8 nozzle and a 50-inch-diameter test section. Except for the nozzle and test section, the circuit of this tunnel was erected by CWS in April, 1957.

Flow uniformity in the 40-inch test section of



Fig. 1. A 40-foot-stroke planer with a milling attachment mounted on an overhead rail was used to machine the huge flexible wind tunnel plates from the slabs. Each plate was on the planer three months, running two ten-hour shifts a day with two full-time operators. Final plate thickness was 0.500 inch.

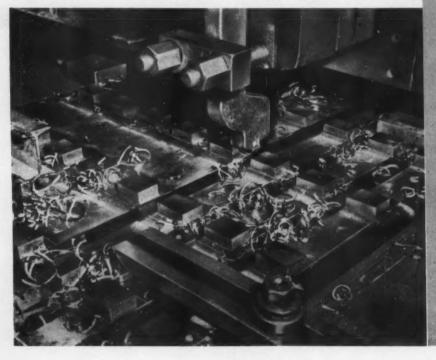


Fig. 2. Close-up of slotting cuts in a flexible nozzle plate for the supersonic wind tunnel. The flex-plates were machined to approximately a 1/2-inch thickness from 4-inch-thick slabs of Stainless-W steel. About twenty different machining operations were required to achieve the tolerances and fine finishes.

Fig. 3. Milling the lug configuration from a solid Stainless-W slab to make the upper flex-plate for a wind tunnel. About two-thirds of the total machine time was taken up in the lug milling operation because of required tolerances.



Tunnel A is provided by a new method of supersonic nozzle design, shown in the heading illustration, using plate profiles designed for continuous rate of change of curvature. The plate thickness, actuator spacing, and precision adjustment of each actuator insure that the slope of the plate differs from the required slope for uniform flow by a small dimension. This feature insures attaining a Mach number uniformity within close tolerances, making test data more reliable.

Tunnel A is equipped with a supersonic nozzle formed by two flexible U.S. Steel Stainless-W steel plates moved between flat side walls by electrically driven actuators. Similar flexible nozzles are installed in the two intermittent tunnels, but their contours are adjusted by manually operated jacks. These refinements included complete design of the side-wall removal device, tooling, and complete metallurgical and physical testing to make possible the use of commercially a railable

Fig. 4. For use in a supersonic wind tunnel the nozzle side-wall plates have to be polished to a mirror finish to eliminate undesirable flow effects in the operation of the supersonic wind tunnel. The polishing machine was adapted from a professional floor sander.



materials. The research projects added greatly to the physical data on welded Stainless-W.

The flexible plates for Tunnel A were machined to approximately a 1/2-inch thickness from 4-inch thick slabs of Stainless-W steel which had been heat-treated to about 160,000-psi minimum tensile strength at a required 90,000-psi proportional limit. About twenty different machining operations were required to achieve the extremely close tolerances and fine finishes. The plate was 40 inches wide, 22 feet long, and contained approximately 300 lugs (Fig. 1) which were machined from the solid. When the plate was installed in the wind tunnel, each lug was attached to a plate support beam (heading illustration), which in turn was attached to an electrically driven actuator. Thus the plate can be flex-positioned accurately for assuming the proper Mach number nozzle profile.

During machining of the plate, great care had to be taken to minimize machine stresses. Therefore it had to be turned over many times in order that light cuts could be taken alternately on each side to equalize stresses. To accomplish this, Consolidated Western Steel developed a special handling fixture which kept the plate from taking a

permanent kink or bend.

A 40-foot stroke planer with a milling attach-

ment mounted on an overhead rail was used in the operation, Fig. 1. Each plate was on the planer three months, running two ten-hour shifts a day. Two operators were kept on the job at all times.

Rough cuts varied from 1/16- to 1/8-inch chip load per stroke, with finish cuts held to 0.010 to 0.015. Milling the lug configuration from a solid block required about two-thirds of the total machine time because of required tolerances, Fig. 3.

After final machining and before inspection, the flexible plate was hand-polished to a mirror finish.

Nozzle side-wall plates also were polished to a mirror finish to eliminate undesirable flow effects in the operation of supersonic Tunnel. A. The stainless-steel plate was finished to a waviness tolerance (in any direction) of less than 0.001 inch in 3 inches. To accomplish this, Consolidated Western modified an ordinary floor sander, Fig. 4, followed by hand polishing.

Before attaching the double-ram actuators to the flex-plate for shop testing at the Los Angeles plant, each of the plate's 300 lugs was tested with strain gages, Fig. 5, to insure that handling and flexing operations would not cause undue stresses and strains in the plate.

Projects tested in the GDF include such weap-



Fig. 5. Strain gages are applied to the lugs to insure that handling and flexing operations will not cause undue stresses and strains in the plate. As part of the throat of the wind tunnel, the stainless-steel walls can be flexed while the tunnel is operating during experiments, thus providing continuous control of speeds in the supersonic range.

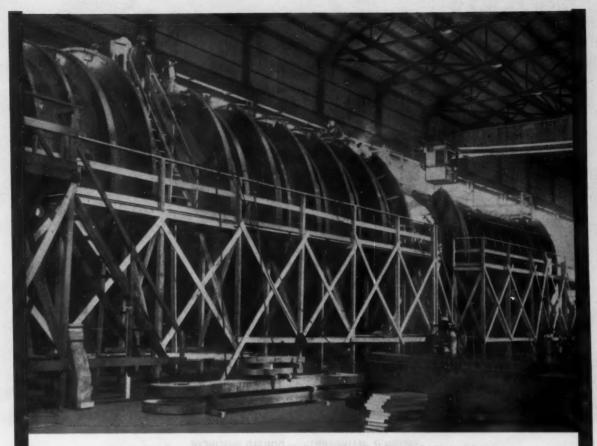


Fig. 6. The first of two test cells for the Engine Test Facility of the United States Air Force's Arnold Engineering Development Center is shown during fabrication at the Vernon plant of United States Steel's Consolidated Western Steel Division. The cell has a diameter of 16 feet and a length of about 90 feet.

ons as the Atlas, Titan, Thor, Jupiter, B-58, Hustler, Redstone, Nike Zeus, Falcon, Pershing and Dynasoar, plus the X-15 and Mercury space project vehicles.

Another major laboratory of the AEDC built by the United States Steel Division is the newest portion of the Engine Test Facility. This unique engine test laboratory enables scientists to simulate complete flights, from take-off to landing, for the supersonic, more powerful propulsion systems of the future. Operating conditions nearly four times the speed of sound and altitudes substantially above 80,000 feet can be created here. Both jet and rocket engines are tested.

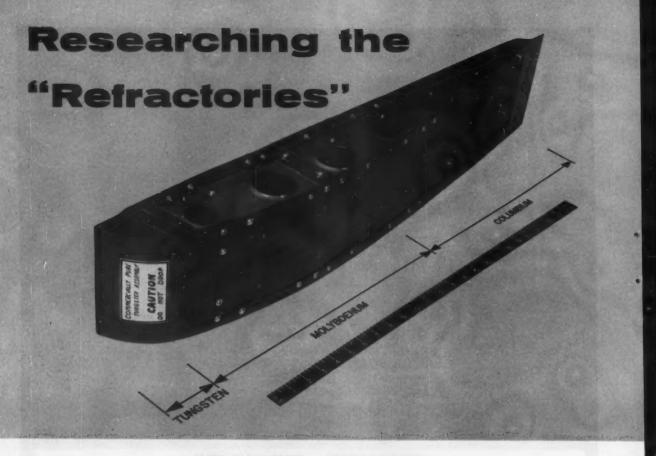
This facility uses the 60,000-hp air-supply and exhauster systems of the original Engine Test Facility, and augments them with powerful compressors and exhausters of its own. Huge heaters, coupled with the refrigeration and cooling equipment of the ETF, are used to provide testing temperature ranges of less than minus 110 degrees F.

to over 750 degrees F. This permits realistic duplication of the high temperatures of supersonic flight as well as the extremely low temperatures encountered at high altitudes.

The versatile laboratory is designed to provide for simultaneous variations of speed, altitude, temperature, and angle-of-attack for continuous simulation of the engine operating conditions experienced in complete flight trajectories. No other facility in the United States has this capability.

Engines being tested in the new portion of the facility will be installed in either one of two test cells, Fig. 6. Both cells and their supporting facilities were built by Consolidated Western. The first test cell, called J-1, has a diameter of 16 feet and a length of about 90 feet.

J-1 cell can accommodate direct-connect, steady-state and transient testing, and fixed nozzle, free-jet testing. J-2 was designed for free-jet testing of large-diameter engines at variable angles of attack and flight Mach number.



JOSEPH H. MAINHARDT DONALD WEISINGER

Group Engineers, Manufacturing Research and Processes Department Republic Aviation Corporation, Farmingdale, N. Y.

TECHNIQUES FOR MACHINING and forming tungsten, molybdenum, columbium, and tantalum—the so-called "refractory" metals—are undergoing continuous study at Republic Aviation's Manufacturing Research and Processes Department. Although these metals lack specific application in today's aircraft and missiles, their use will be mandatory in the space vehicles now on the drawing boards.

Republic entered the quest for abnormally high-heat-resistant materials via the speed-brake door: On its F-105 fighter-bomber, four such doors are hinge-joined to the aft section of the jet engine. In normal flight, the doors form a funnel through which the hot (1800 degrees F.) exhaust gas passes. To brake the ship for maneuvers or for landing, the doors open radially, like the petals of a flower.

None of the various nickel alloys first used for the doors withstood the intense heat, and warping became a major drawback. The problem was not shared by other airframe manufacturers—

this type of speed brake being a Republic Aviation concept—so the company went on a materials hunt all its own with full vigor. The result was a composite door of Rene 41 and titanium B120VCA.

These "superalloys," while not considered refractory metals, have successfully resisted the heat of the exhaust gas. But they have also resisted machining! Extremely tough even in the annealed condition, they are difficult to drill, mill, shear, and form. Neither high-speed-steel tools nor carbide tools have demonstrated a satisfactory useful life.

In milling the Rene 41, for example, chips invariably weld to the cutting edges. The problem, however, has been greatly reduced in severity by simultaneously applying both a liquid and a spray coolant to the cutter. (Neither coolant proves effective when used alone.) Again, because the titanium has to be formed hot, company researchers have conceived and developed integrally heated tooling of beryllium copper.



Electrolytically assisted grinding of the edges of a tungsten sheet. Probably the most difficult of all metals to grind, tungsten requires a very strong electrolyte as well as positive electrical contact with the holding fixture.

Other new techniques are being devised continually to simplify the processing of the speed-brake doors. As the inventory of information about working the superalloys builds up, it has been found that much of it forms a good starting point for the company's growing interest in the refractory metals. Progress in this respect is dramatized by the wing section seen in the heading illustration. To create this composite, the three refractories used—tungsten, molybdenum, and columbium—had to be formed more severely than had ever been previously attempted.

Investigations in the main have been limited to tungsten, molybdenum, and columbium. The fourth refractory, tantalum, will eventually be given greater attention. All, because of their high melting point, are difficult and costly to reduce from ore to mill product. Compared to more common materials, present prices are virtually prohibitive—\$50 to \$80 per pound for tungsten, about \$50 per pound for molybdenum, and about \$150 per pound for columbium.

Of the four, tungsten seems to be the material for high-temperature applications. It is, however, both impossible to machine and impossible to

weld by conventional methods. High in strength when heated, at room temperature it completely lacks ductility and is so brittle it will break if dropped. At 950 degrees F. the material becomes machinable. Work must not, however, be held at this temperature too long, or machined at any higher temperature; otherwise, oxidation sets in rapidly.

Drilling is being done with the aid of cartridge type induction heaters. These heaters are inside a copper block on which the work rests. Twist drills are high-speed steel containing 8 per cent cobalt, and the drill web is thinned at the point. In lathe experiments at room temperature, carbide tools averaged only 1 inch of turning length for their useful life.

Milling (conventional, not climb) has received considerable attention. Grade C-2 carbide inserts have produced a fair finish. A special set of copper jaws has been used for milling flat specimens. These jaws are fitted with heaters, controls, and instrumentation to furnish a precise temperature level. With thin specimens, the sides must be sandwiched in soft-steel supporting plates which are milled at the same time.



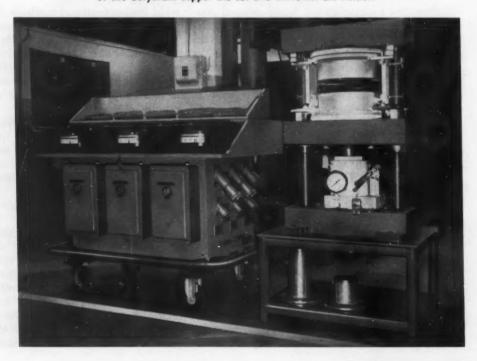
Drilling a tungsten specimen on a heated platen. Both thrust and torque forces are picked up on a strain-gage dynamometer setup. Findings help to determine tool life and optimum drill-point configuration.

Studies are now being made on the possible effects of oxidation and contamination caused by the jaws and the heat, but a preliminary analysis indicates that these factors can be controlled. Beryllium copper is being considered in place of pure copper for tooling, to avoid the catastrophic amount of scaling that is now taking place.

Induction heating is being investigated for milling heavier tungsten sections. The relatively poor response of tungsten to induction heating requires large power units and intricate tooling setups. It is expected that problems still prevalent in this area will be resolved.

Grinding the tungsten raises havoc with the wheels, regardless of grit size, grade, concentration, or bond, and usually causes a bad flaking, or delamination, of the work. Apparently, only electrolytically assisted grinding with a diamond wheel is effective, and even here, problems exist.

Refractory metals are formed at elevated temperatures on this Republic-built hydraulic press. The electrical power cart on the left controls the temperature of the beryllium-copper die set and universal die-holder.





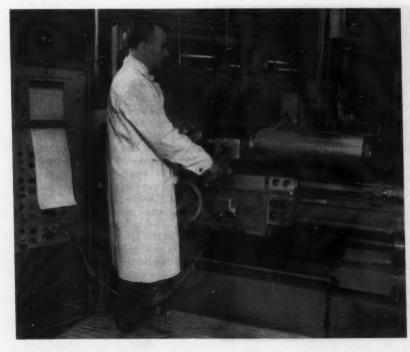
Quartz lamps on the shear quickly raise the refractory sheets to temperature. To avoid cracking and delamination, tungsten is sheared at 900 degrees F.; molybdenum (with 1/2 per cent titanium), at 500 degrees F.

The usual electrolyte has not been strong enough. Also, because of the low conductivity of the material, it has to be held on the machine table in steel plate liners.

At 1000 degrees F., tungsten can be formed satisfactorily with bend radii as small as three times metal thickness. Edges must be round, smooth, and free of nicks. Even when the material is formed successfully, it is subject to delayed cracking. This indicates that a higher forming temperature or an annealing operation will be re-

quired to reduce or dissipate locked in stresses.

Die sets and die-holders are cast of beryllium copper and are integrally heated. This alloy is both nonoxidizing and nongalling. It has excellent thermal conductivity (three times that of steel) and withstands use of elevated temperature (not true of Kirksite). Through an Air Force-sponsored research program, Republic engineers are casting die sets and die-holders to extremely close tolerances (±0.002 inch) and good surface finish (70 micro-inches).



This special "machinability" lathe and strain-gage dynamometer determine the cutting forces on a bar of molybdenum alloy. The test constitutes a logical starting point for establishing a machinability factor for a new material.

Once the dies reach heat, relatively low forming pressures are required. Blanks are coated with a hot-die lubricant. Best results are obtained with a dwell interval, after closing the dies, of about five minutes. This relieves stresses and reduces the amount of spring-back.

Prior to forming, it is, of course, necessary to shear the tungsten to the required blank size. Shearing at room temperature causes the material to flake badly. No trouble exists at 900 degrees F. To heat the work, the shear is equipped with a battery of 8000-watt quartz lamps. These lamps are focused on the tungsten sheet as it is fed into the shear. To improve the process further, an integrally heated shear is now being designed. This will cut the heat loss through radiation which is now experienced with the lamps alone.

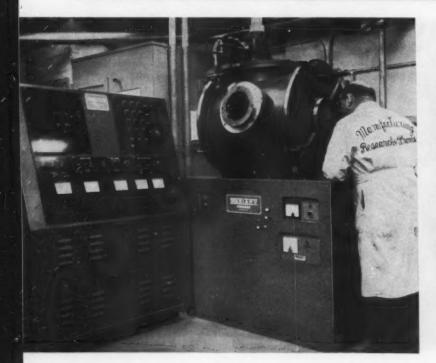
The other two refractory metals currently under investigation at Republic—molybdenum and columbium—show more adaptability to conventional machining methods than does tungsten. Molybdenum work must be well supported. It cannot be turned or milled to a sharp corner; a ground radius is necessary. When alloyed with 1/2 per cent titanium, molybdenum exhibits the forming characteristics of tungsten, and heat is indispensable to bending and shearing.

Tests of machinability of molybdenum showed

that Grade C-1 carbide stood up best for roughing cuts, because of the severe impact involved. Grade C-2 performed well and provided a good finish for lighter cuts. Lathe tools ground with a side clearance angle of 20 to 25 degrees produced a continuous chip. Milling cutters with 0 to 5 degrees positive rake proved effective.

It was found that the tendency of molybdenum to flake on the side toward which the cutter is feeding can be overcome by starting the cuts from each end of the specimen and blending them in the center. Another way is to use a tool with a large side-cutting edge angle and feed it slowly as it is about to leave the work. Sharp cutters are essential for finishing, and the chips should be directed away from the work, to reduce the material's tendency to gall and tear. The use of a water-miscible coolant extended tool life and improved surface finish. In milling, an air blast used in conjunction with the coolant gave the cutter even greater life and helped dislodge chips from the cutter teeth.

Investigations of the refractory metal columbium showed that when alloyed with 10 per cent molybdenum and 10 per cent titanium, it could be sheared and formed at room temperature, provided no severe shrink areas were involved; otherwise, here too, heat was necessary.



Republic Aviation Corporation, Farmingdale, N. Y., has scored an airframe industry "first" with the acquisition of this Sciaky electron-beam welder for its Manufacturing Research and Processes Department. equipment bombards the edges to be joined with a concentrated beam of electrons. Kinetic energy of the electrons is changed to heat, melts the edges of the work, and produces a fusion weld. The most significant aspect of the process is that welding is performed in a vacuum, retaining the ultra-high purity of space-age metals like uranium, zirconium, beryllium, tungsten, molybdenum, and tantalum.

# Exposition and Standardization— Themes of Machine Tool Builders

A WAVE of plant modernization that will sweep the country as a result of the Machine Tool Exposition—1960 was the hope of Alan C. Mattison, president of the Mattison Machine Works and president of the National Machine Tool Builders' Association, at the annual spring meeting of the Association held at the Hotel Roosevelt, New

York City, on May 5 and 6.

In his address, Mr. Mattison discussed the growing threat of foreign competition to the metalworking manufacturers of the United States. He said, "Competition has gone international. Imports have been going up and exports down. We have been advancing wages and prices apparently on the assumption that we could keep on doing that forever. The hard fact is that as a nation we are pricing ourselves out of our markets. The only way for manufacturers to meet foreign competition is to reduce costs and transform technology into lower prices—in short, again become competitive.

"How are manufacturers going to get their costs down? Is there any prospect of lower taxes,

or lower wages, or lower material costs?

"There is only one way, as I see it, open to the businesses of this country, right now, to cut costs in order to meet the growing threat of competition of the lower-priced imports. That way is to modernize plant and equipment. That is why the Machine Tool Exposition—1960 is so important.

"Technology on behalf of increased productivity is now moving ahead at a rate never seen before. It isn't necessary for American metalworking manufacturers to accept foreign competition as an unbeatable proposition. It is not too late. When metalworking executives see the possibilities of the new machine tool models to be exhibited in Chicago, they will realize that with these machines, plus anti-inflation management measures, they can regain control over costs, they can reduce costs, they can once again offer better things to more people at lower prices."

In his talk "He that Nothing Questioneth Nothing Learneth," W. E. Rutz, executive vice-president of the Giddings & Lewis Machine Tool Co., referred to the large number of foreign machine tool exhibitions. He pointed to the popularity of these shows as a means of providing buyers with the opportunity to see available products.

Mr. Rutz mentioned that the European shows have more floor space available than the Chicago

Amphitheatre. However, he pointed out that there are many more exhibitors so that displays are cramped and often ineffective. For example, at the recent Paris Show with 400,000 square feet of floor space, there were 330 German, 315 French, 97 Swiss, 90 Italian, and 64 British exhibitors, not to mention lesser numbers from other countries. At the Chicago Amphitheatre there will be a total of about 150 exhibits spread over an area of 340,000 square feet of actual display space.

Mr. Rutz pointed out that the key to economic growth is regular investment in knowledge, which in turn leads to technological progress and innovations. He predicted that the coming exposition will be even more outstanding than those

of the past.

Donald H. McIver, vice-president of the Ex-Cell-O Corporation and chairman of the Machine Tool Exposition Committee, stressed the desirability of exhibitors meeting the "target" dates for the arrival of their displays. He explained the facilities for handling the equipment to be shown and also the arrangements made for registration, transportation, and restaurant service. He stressed the need for early hotel reservations.

Don Knowlton of Hill & Knowlton, public relations counsel, and George A. Hawkins, director of sales promotion and market research, Brown & Sharpe Mfg. Co., and chairman of the Machine Tool Exposition Advertising Committee, discussed promotion activities. They especially praised the technical magazines serving the metalworking industries for their generous cooperation. There was also a panel discussion of

details of the exposition.

One of the high points of the opening day was a panel meeting of the "Users" Standardization Coordinating Committee which presented recommendations for standardizing certain dimensions on milling machines, lathes, drilling machines, and grinding machines. A plea was made for cooperation in setting up a committee with representatives from machine tool users and builders and from the Department of Defense. On the "Users" coordinating committee, the following concerns were represented: International Harvester Co., Ford Motor Co., General Motors Corporation, Chrysler Corporation, John Deere & Co., Mack Truck, Inc., Herzberg Corporation, and International Business Machines.



# **Norton Opens New Grinding-Wheel Plant**

A \$6,500,000 PLANT for the manufacture of organic-bonded grinding wheels was unveiled this May at Worcester, Mass., as Norton Co., abrasive products maker, started celebrating its seventy-fifth year in business.

Besides increasing the capacity for making resinoid-, rubber-, and shellac-bonded grinding wheels, the new facility has improved product quality and has streamlined processing. The time for making many types of wheels has been reduced 25 to 50 per cent. Wheels have better inherent balance, made possible by automatic production equipment, and are more uniform from lot to lot.

Automatic weighing equipment, for example, draws from storage tanks the correct amounts of abrasive grain and bonding material. Three weighing carriages, suspended from a monorail, travel in a loop under a row of raw-material tanks. To operate the system, a stack of punched cards is placed in a dispenser at the beginning of the cycle. As a carriage is brought into position, the dispenser issues one card to it representing one batch of mix. The card then takes over the control of the carriage, automatically indexing it with the proper tanks and filling its hopper with the correct amount of each ingredient of the mix. When all the ingredients are drawn, the carriage moves around the loop to the mixing area. where the hopper is automatically discharged onto a spur monorail at one of nine mixing positions indicated on the punched card. Before returning to the beginning of the cycle, the carriage receives an empty hopper, again automatically, and the cycle repeats with a new card. Each card becomes part of the record for its own batch of wheels.



(Above) This automatic weighing equipment is controlled by punched cards. Operator places cards in dispenser, then the grain and bonding material are metered to hopper of carriage in weighing station of equipment.

(Left) Cutoff wheels are made on this three-station press. Mold is filled at one station. material pressed into shape at second, and wheel removed at the third by operator.

A modified honing operation brings the holes of these resinoid-bonded wheels to the correct size.

Another piece of equipment is a three-station hydraulic press which molds reinforced resinoid cutoff wheels. By using a turret device, production per man-hour of these wheels has been tripled. At the first station, the mold is automatically and uniformly filled with the correct amount of abrasive and bond mix. At the second station, the mix is pressed hydraulically. The operator, at the third station, removes the pressed wheel and readies the mold for the next cycle. All of these operations are performed simultaneously, so production is at a high rate.

Pressed wheels are heat-treated in continuous ovens to cure the organic bonds. Controls which automatically maintain the correct temperatures in the ovens are conveniently located on overhead galleries. Finishing the wheels (other than cutoff wheels) after the heat-treatment is also a critical step in the maintenance of quality. Sides of the wheels are ground parallel and straight on a Norton-built machine. After the sides have been finished, the holes are brought to correct size, straightness, and concentricity on an adaptation of a honing machine.

After the wheels have been trued to the correct outside diameter, they are inspected for balance, correct grade and dimensions, and appearance. Another important step in the inspection of all wheels 4 inches and larger in diameter is speed testing. The wheels are operated well in excess of the maximum recommended operating

speed to assure that there are no hidden flaws. Following inspection, the wheels are marked with the specification and trademark and sent to shipping for immediate delivery, or to the stock racks as part of the large inventory of commonly used wheels.

The mixing and molding area of the plant is air-conditioned because of the nature of the materials used. Temperature is maintained between 68 and 78 degrees F., and humidity is held between 35 and 45 grains of water per pound of dry air. Areas where air conditioning is not required have forced ventilation, with a complete change of air every hour in the winter, and four to six changes in the summer. Dust collectors eliminate the odors from the organic bonds used.

All wheels receive a final inspection in this area of new plant. Some 200,000 varieties of wheels are available, with 20,000 of them in stock on 26 miles of shelves.



# **MACHINERY** Salutes:

Francis A. Pratt, 1827-1902

Amos Whitney, 1832-1920

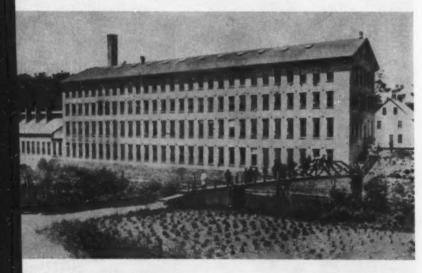


100
YEARS
OF
ACCURACY



A HUNDRED YEARS AGO every gun and rifle had to be bench-made by a gunsmith. There was no such thing as accuracy as we know it today. This year we celebrate the fact that a hundred years ago two Connecticut men "discovered" accuracy. They started a tiny firm that began making gun parts that were interchangeable. To do this meant devotion to uniformity in dimensions and the development of the equipment to produce parts having the necessary precision. It also meant developing devices for measurement, plus the establishment of dimensional standards.

Today these principles, by which this two-man team worked, are an expression of the concept of repeatable interchangeability that makes today's mass production an actuality. The firm they started one hundred years ago is now the Pratt & Whitney Co., Inc., West Hartford, Conn. The celebration of the company's centennial started on May 7 and culminated in a dinner on May 18 which brought together more than 300 of Connecticut's industrial, business, and civic leaders. In his address honoring the company, Governor Abraham Ribicoff said: "Industry provides the

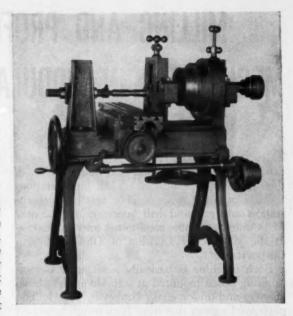


The first Pratt & Whitney plant. Built 1865, Hartford, Conn., on the banks of the Park River, facing garden. foundation of Connecticut's economy, and Pratt & Whitney Co. is one of the foundation stones of Connecticut industry. The state is proud of your energy, your skill, and the quality of your craftsmanship." Among the world's tool users, the influence of Pratt & Whitney is, of course, greater and more penetrating than its effect on Connecticut's economy.

Francis Pratt and Amos Whitney, the founders, were true mechanics. Their other talents complemented each other. Where Whitney was skilled, inventive and more of a shop man, Pratt had a flair for the dramatic which makes a good salesman. However, his sales approach was tempered by his native sense of mechanical feasibility. What he sold could usually be made in the shop. The partnership started one hundred years ago in a single rented loft room, making interchangeable parts for guns: then accurate machine tools for making the parts; and finally the gages to check uniformity and precision. The company, in the 1880's, was instrumental in establishing the first "standard inch." Several of its first machine tools -a lathe, a planer, and a milling machine-are in the Ford Museum collection at Dearborn, Mich.

Pratt & Whitney's present home in West Hartford is the 115-acre site that was formerly Charter Oak Park, a fair ground famous in the Gay Nineties for harness racing. The modern plant, consisting of 1,250,000 square feet, is surrounded by spacious tree-shaded lawns and recreational areas for its 2650 employes.

Pratt & Whitney Co., down through the years, and throughout the world, has been a recognized authority on precision measurement, "toolroom" machine tools, and cutting tools. The famous line of Keller die-sinking machines and the Potter &



The first Pratt & Whitney milling machine built in 1860 was this treasure named the "Lincoln Power Miller" after President Abraham Lincoln. It is now in the Ford Museum collection in Dearborn, Mich.

Johnston turret lathe are also products of this concern.

MACHINERY magazine takes the greatest pride in congratulating Pratt & Whitney on the completion of its first hundred years, and extends to the company its best wishes for a second century of continued accomplishments in the kind of accuracy that has made the United States toolmaker to the world.

Machine tool builders Francis Pratt and Amos Whitney pose with key men of sales and manufacturing staff, 1886.



# MILLING AND PROFILING OPERATIONS MECHANIZED IN MODULAR TRANSFER MACHINE

LAURENCE W. COLLINS, Jr., Associate Editor

THE BUILDING-BLOCK principle has been used by the George Gorton Co., Racine, Wis., in the design and building of its first linear stationtransfer profiling machine. The first two sixteenstation units mill and drill "receivers" for the new M-14 automatic rifle, soon going into production at the Winchester Division of Olin Mathieson

Corporation.

Each machine is basically a series of Gorton profiling heads mounted at suitable angles above an over-and-under chain conveyor, Fig. 1. The parts are forgings that have been rough-broached to preliminary size. The alloy behaves similar to a resulphurized AISI 4150 steel at 223 Bhn. With a single operator, one of these transfer machines does what would ordinarily require sixteen operators at conventional machines. The conveyor also does away with much materials handling.

The transfer is built around a heavy, over-andunder roller-chain conveyor on which are mounted the platen fixtures that hold the work. A great deal of the success of this machine is traceable to the design of the platens and the method by which they are located precisely and clamped at the several stations, Fig. 2. The fixtures are "zeroed-in" on their platens by autocollimation for precise location. Each platen is individually located at a given machine station by hydraulic plungers from beneath. The tors of the plungers are V-shaped to mate in slots in the bottom of the platen, assuring precise linear location at each index.

The platens are also lifted by the plungers against positive stops. The stops are heavy rails of steel machined to an L-section and bolted to the base on each side. One leg of the L-section overhangs the top edges of the platen on each side, Fig. 3. Thus the stops set the height of the platens at all stations, insuring precise depth of stock removal at the index.

Fig. 1. Modular sixteen-station transfer profiling machine viewed in the last stages of erection. The platens will be bolted to the holders on the conveyor. Each station has exterior hydraulics.





Fig. 2. The loading station has all station controls in easy reach. Overhead indicator signals status of each station.

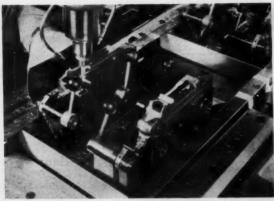
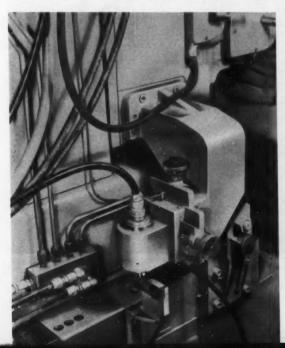


Fig. 3. Twin-fixture platen demonstrates how the rifle receivers are held. The work-piece (right) is as-broached.

During profile milling, three faces of each receiver blank are presented to the cutters. Each platen has two work fixtures, side by side. The fixture on the front holds the part while the top is machined on the first cycle pass. When a given part has returned to the loading station on the first pass, it is removed, turned over, and clamped in the rear fixture of the same platen to machine the bottom of the part, and a new blank is clamped in the front fixture. The coolant is a "fog-mist" of rich, soluble oil emulsion directed at the tool. The cutters are M-3 high-speed steel and operate at approximately 220 surface feet per minute.

The first of several multiple-station, in-line transfer machines (each tooled slightly different) to be delivered to Olin Mathieson utilizes

Fig. 4. A Lucite template controls the gun-sight base cavity profiling station through a 360-degree tracer system.



a Gorton 360-degree Auto-Trace electrohydraulic tracer system at the seventh station. It profile-mills the gun-sight base section of the receiver, a rectangular cavity. The traverse feed rate of the spindle head is controlled through the use of the "In-Cycle" feed regulator. This unique control is built around the company's standard tracer head, operating from a Lucite template, Fig. 4. Traverse of the head is at normal speed while the probe is in contact with Lucite. However, metal inserts are built into the Lucite at corner locations. When the probe touches an insert a circuit is completed which automatically slows the traverse while the cutter profiles a sharp corner.

The designs of all of the machines for the M-14 receiver program embody the true building-block concept. There is a great similarity of many horizontal and vertical machining stations to the company's 1-22 Mastermills. Heads often are positioned at off-square angles so that standard cutters can be used to the greatest extent (Fig. 1).

The chip-removal problem was complicated by the sheer weight of stock removed from the forgings. The piece part at the start weighs 39 ounces, and when completed it weighs only 22 ounces. With 17 ounces of chips to be handled for each completed piece, a vacuum system picks up part of the chips in mid-air near the tools. As the conveyor goes over the far pulley, chips that fall down are dumped onto a conveyor. On the return flight of the conveyor, underneath the machine, the fixtures and work are washed in inverted position by a spray flood of soluble oil.

The use of the building-block principle has permitted these machines to be constructed and delivered in a short lead time and at reduced expense because many whole head assemblies could be picked "off-the-shelf." Also, standard milling tools can be used in most cuts because the heads can be positioned in any plane.

# LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

# Cincinnati Angular Wheel-Slide Grinding Machines

Diameters and adjacent faces of shafts can be ground simultaneously and the critical dimensions, angles, and corner radii established at the same time by machines now being built by the Grinding Machine Division, Cincinnati Milling Machine Co., Cincinnati, Ohio. These Filmatic semi-automatic angular wheelslide grinding machines, one of which is shown in Fig. 1, are built in two sizes specifically designed to

combine rapid outside-diameter and shoulder grinding in a single, automatic cycle. Typical parts ground on these machines include crankshafts, steering knuckles, gear blanks with hubs, and stepped shafts with critical flanges, tapers, and shoulders. Built to feed at either 30 or 45 degrees, these machines produce a superior circular-line finish instead of a criss-cross pattern.

Generally, work-pieces having a

long ground diameter and low shoulder height are better suited for processing on a 30-degree wheel-slide machine while parts having a shoulder height equal to or exceeding the diameter are better adapted for handling on machines with a wheel-slide that is designed to feed at an angle of 45 degrees.

Automatic behind-the-wheel profile truing equipment, Fig. 2, provides fast, accurate grinding-wheel

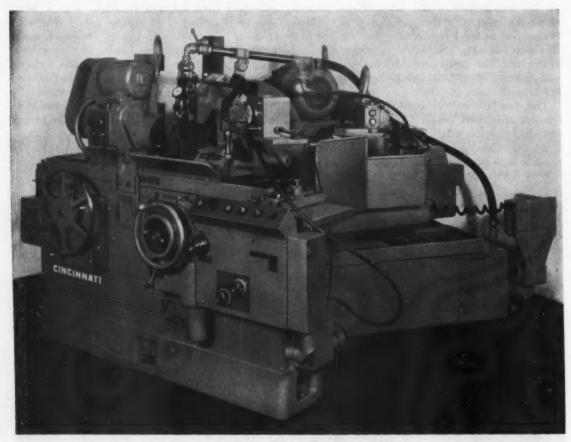


Fig. 1. Angular wheel-slide grinding machine built by the Grinding Machine Division, Cincinnati Milling Machine Co.

# IN

# SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

truing with provisions for two to ten passes with or without diamond advance on the last pass. This equipment can be set to true the wheel after a predetermined number of work-pieces have been ground. Automatic balancing of the grinding wheel can be accomplished in seconds on these machines. The grinders are equipped with Cincinnati's self-adjusting Filmatic bearings in which the wheel spindle rides on a wedgeshaped cushion of high-pressure oil created by the interaction of the spindle and bearing shoes.

Operator convenience is said to be an outstanding advantage of the automatic infeed cycle. When the grinder is set for automatic operation, pressing the wheel-headadvance button initiates an automatic cycle that hydraulically clamps the table, rapidly advances the wheel-head, and starts work rotation. Grinding then proceeds at a fast feed rate followed by a slow feed rate and dwell. Rapid return of the wheel-head, stopping of work rotation, and unclamping of the table completes the automatic cycle. Sizing adjustments as fine as 0.00005 inch on the work diameter are made possible by the hydraulic motor drive of the infeed screw. The V-belt headstock drive assures smooth work rotation for high-quality finishes.

If desired, the grinder can be provided with automatic air-electric-gage sizing equipment that incorporates a cycle-time stabilizer which automatically corrects the grinding time cycle to compensate for wheel wear. An automatic gap eliminator is offered to reduce time wasted in "cutting air" during the infeed grinding cycle. A simple, accurate flagging device, either manual or automatic, is also available for axial location of work.

Circle 565 on Readers' Service Card

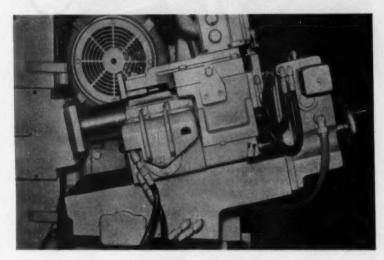
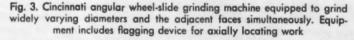
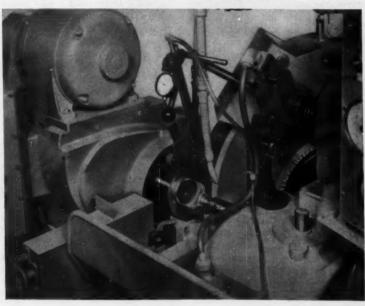


Fig. 2. Behind-the-wheel profile truing equipment of machine shown in Fig. 1 which can be set for a variety of automatic truing cycles





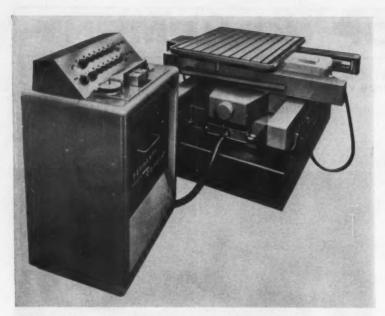


Fig. 1. Machine work-table equipped with Ferranti punched-tape, numerically controlled positioning system introduced by Bendix

# Bendix Adds Ferranti Equipment to Line of Numerical Control Systems

The Industrial Controls Section. Bendix Aviation Corporation, Detroit, Mich., now sole distributor and service representative in the United States for machine tool numerical-control systems manufactured by Ferranti, Ltd., England, announces the availability of Ferranti equipment for punchedtape positioning, Fig. 1; magnetictape contouring, Fig. 2; and coordinate inspection, Fig. 3. The addition of this equipment will not affect the present numerical-control research and development program of Bendix.

The Ferranti system, Fig. 1, is designed for rapid point-to-point positioning of work on machine tools performing drilling, machining, or boring operations. Information stored on punched tape is read by electronic equipment and transmitted to electric motors or hydraulic drives that move the work-table simultaneously in two directions. In addition to positioning data, the punched tape can provide up to twenty-five separate signals for performing auxiliary machine-control functions such as down feed, coolant flow, and feed and speed selection. Positioning data on the tape is in the form of

absolute coordinates for each point.

Two sets of six dials, one for the X coordinates and the other for the Y coordinates, permit manual selection by the operator of any coordinate position up to 99.9999 inches. Larger ranges for manual position selection can be readily provided for machines of greater capacity. Depressing a start button after the coordinate dimensions have been set on the dials causes the machine table to move automatically to the selected position. An optical-grating measuring system fitted to each table movement provides a feedback arrangement that assures repeatability as well as machine accuracy which is independent of the lead-screw accuracy of other mechanical elements.

Positioning feed rates of up to 200 ipm can be provided by the system depending upon the application requirements and design of the machine tool. The electronic resolution often may be as small as 0.000040 inch with the Ferranti numerical-position system.

The Ferranti contouring type control system, Fig. 2, is designed for application to two- and threeaxis small and medium-size machine tools. In this system, information stored on magnetic tape is read by electronic equipment and transmitted to hydraulic servo drives that move both tool-head and work-table to provide a continuous machining cut. Accuracy of the machine movements is continuously controlled and checked throughout the machining sequence by a unique optical measuring feedback system utilizing optical gratings attached to the moving machine elements. Use of gratings for feedback permits flexibility in the selection of power drive since accuracy is dependent upon the gratings and not upon loading, lead-screws, or cylinders.

The optical measuring system utilizes a combination of an optical grating, a light source, a photocell, and a rotating disc with a spiral pattern printed on clear glass. This arrangement generates a feedback signal that is compared in the control console with the command signals stored on the tape. The control system, in turn, uses the difference between the command and feedback signal, through electronic servo amplifiers to control the speed and direction of the machine slides.

The magnetic tape, which stores all machining information and auxiliary machine functions, is read at a speed of 3 3/4 ips, thus providing a total continuous machining time of three hours and ten minutes for one reel of tape. Magnetic tape for the contouring system is prepared on a transistorized tape-preparation unit that has been developed by Ferranti, Ltd. The unit can prepare a reel of tape in as little as seven minutes. A two-dimensional plot of the part to be machined is generated simultaneously with the preparation of the tape. Transistors and semiconductors are used as circuit elements in the compact, electronic control system.

The Ferranti inspection machine, Fig. 3, is designed to significantly cut the time for accurately inspecting work-pieces compared with conventional indicator, height gage, and surfaceplate checking methods. This versatile equipment utilizes transistorized electronic counting circuits and optical measuring gratings to inspect machined parts by the coordinate method to an accuracy of 0.001 inch.

Work-pieces are mounted on a horizontal surface plate that is an integral part of the machine. To inspect a part, the operator moves an inspection probe in either longitudinal or transverse directions between the points on the part which he wishes to measure. Movement of optical gratings attached to both longitudinal and transverse axes of the machine creates a fringe pattern that activates photocells. Changes in light intensity are converted into pulses that are stored by transistorized bidirectional decade counters.

Measurement information is then presented continuously on two five-figure groups of easy-to-read numbers. Machines that read in 0.001-inch units have an indicator that reads "minus" over the first half of each unit step and "plus" over the second step. This provides an accuracy reading down to 0.005 inch.

The inspection probe has interchangeable tips and is supported by a rigid cantilever-beam arrangement. It can be moved 24 inches in the longitudinal direction and 15 inches in the transverse direction. Low-friction bear-

ings provide a minimum resistance to movements in either direction. Provision is made for a vertical probe travel of 12 inches.

Circle 566 on Readers' Service Card

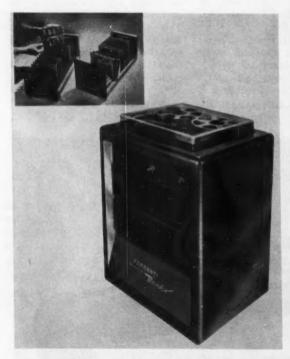
### Ultrasonic Cleaning System Uses Lead-Zirconate-Titanate Transducer

An ultrasonic cleaning system, more efficient for many applications than those using magnetostrictive or barium-titanate transducers, has been engineered by Branson Ultrasonic Corporation, Stamford, Conn. Based on a unique, sandwich type transducer, "Sonogen Z" is available in both high- and medium-intensity versions. Standard tank capacities range from 2 to 75 gallons, consuming 150 to 2000 watts.

Heart of the system is a leadzirconate-titanate transducer, designed to operate at 25 kilocycles. Because it can convert larger amounts of power than bariumtitanate transducers used with 40kilocycle installations, it can be operated as a full-wave system, thus doubling the effective power output per unit area, in turn making for higher cleaning efficiencies.

Although lead zirconate titanate makes an excellent transducer, the main reason for not using it before was that it is very difficult to manufacture in heavy sections. Also, as a raw material it is considerably more expensive than the barium titanate. Branson avoided these drawbacks by designing a sandwich type transducer, using only thin sections of lead zirconate.

Because of their novel construction, Sonogen Z elements can be completely reclaimed from a transducer housing which has deteriorated from cavitation erosion. They are simply transferred from the worn housing to another, thus



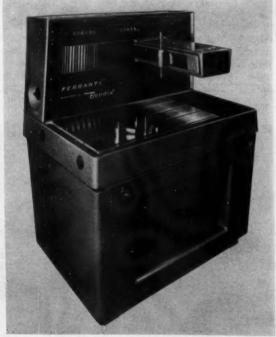


Fig. 2. (Left) Control cabinet using magnetic tape to numerically control two- or three-axis system for machine tools. The inset shows printed transistorized circuits made up in the form of plug-in cards in replaceable, drawer type assemblies. Fig. 3. (Right) The Ferranti coordinate inspection machine that provides a versatile, quick method of checking dimensions on a work-piece by moving a probe from point to point

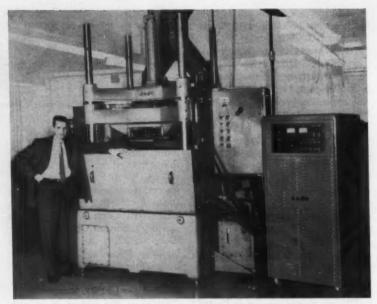
essentially fabricating a new transducer assembly.

The older style of transducer generally has to be replaced completely after 7000 to 10,000 hours of operation. So little can be saved in trying to transfer barium-titanate elements into a new housing, that the cost of repair almost equals that of an entirely new unit. However, with the Sonogen Z transducer, cost of replacing the stainless-steel housing is only about 20 per cent of the initial transducer investment.

Circle 567 on Readers' Service Card

### Engine and Tracer Lathe for Heavy Work

A medium-duty engine and tracer lathe is being introduced by the American Tool Works Co., Cincinnati, Ohio. This "Maxi-Swing" lathe has been designed to handle heavy work up to 40 tons, and will make precision cuts to a depth of 3/4 inch. It is available in four sizes with swings from 74 to 108 inches over the bed which is 56 inches wide and has four hardened and ground replacable Vways. The tracer lathe is completely equipped with carriagemounted power unit and motor, all required hose and fittings, hydraulic tracer valve, angle-tracer slide with hydraulic actuating cylinder, periscope type precision optical viewer, template-holder



Elox electrical-discharge contour-machining equipment

brackets, and adjustable supports for flat templates.

Internal-geared faceplate drive, pendent-controlled operation, including apron-feed clutches, 7 1/2-inch-diameter tailstock spindle, and traveling operator platform are standard equipment for either engine or tracer lathe.

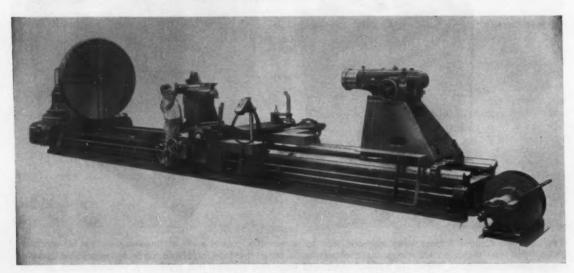
This machine is designed especially for use in steel-mill maintenance, shipbuilding and repair, as well as for missile and similar types of work in heavy industry.

Circle 568 on Readers' Service Card

### Special Contour-Machining Equipment

Elox Corporation, Troy, Mich., announces a new development in the field of electrical-discharge machining with the marketing of its ER-300 roughing power supply. This unit, in conjunction with any Elox machine tool that is equipped with hydraulic feed, has an optimum metal-removal rate of 20 cubic inches per hour, which is about twenty times the rate of pre-

(Continued on page 206)



Engine and tracer lathe introduced by American Tool Works Co.

# This is Stuart's

new
HI-D
at work

This is what HI-D is...



A new transparent metalworking compound a petrochemical compound possessing the high detergency of synthetics but none of their disadvantages. Often described as a hybrid—Hi-D is not truly an emulsion, and not anything like a straight chemical compound. Turn the page to see how this new type of cutting thuid can help you.

This is what

# Stuart's

new HI-D

will do...

Keep grinding wheels open and free-cutting. Permit standardization of wheels—do more different jobs with fewer wheels. Minimize machine tool maintenance. Aid chip formation to produce fine surface finishes. Lubricate efficiently as it cleans. Remain effective and stable at 60:1 for grinding and at 40:1 for cutting—even after picking up tramp oil. Settle chips quickly in an ordinary sump—produce controlled foam in a flotation-type filtering system. Inhibit rust, even at mixtures greater than 60:1.



This is how

# Stuart's

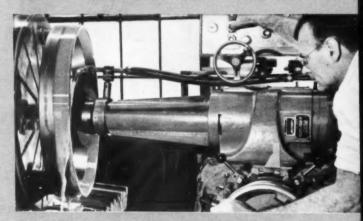
new HI-D

has helped others...

LaSalle Steel Company reduced cutting fluid costs by 45%, using Hi-D for everything from ¼" roughing cuts on lathes to fine finish grinding. At 50:1, Hi-D stops in-plant rust on highly finished steel bar stock.

The Torrington Company, Bantam Bearing Division, saves ½ on lubricant costs by using Hi-D at 60:1 on 87 grinders. Hi-D trims hidden costs, too, because Torrington dresses wheels only ½ as often as before. Think of the savings in wheel and diamond life. Direct costs are slashed on some jobs because both roughand finish-grinding are done with the same wheel. As for finish, Hi-D eliminates 95% of chip "feedback" from the filtering system.





# Stuart's HI = D replaces five cutting fluids in diversified plant

Here's how Hi-D's combination of detergency and lubricity slashes lubrication costs for one company on 20 different jobs that range from sawing to surface grinding:

- Sawing—Elimination of chip welding improves blade life. Ability to perform at 10:1 (5:1 formerly required) reduces carry-off and waste.
- Turning—Production is increased by stepping up feed from .030 to .060 ipm. Depth of cut is increased from %" to %".
- 3. Mills-Rancidity is eliminated.
- Surface grinding—Wheel life is increased, downtime is decreased, because petrochemical compound Hi-D keeps wheels open and free-cutting.

On every application, Hi-D matches or betters the performance of five compounds replaced. Cutting fluid inventory and handling costs are reduced. Using Hi-D in the toolroom and cutoff department (serviced by a central system) saves 50 to 60 gallons of cutting fluid per week.

The way to evaluate potential savings in *your* plant is to test Stuart's new Hi-D on a variety of operations. Or, send for free test samples of Hi-D in both concentrate and mixture form that will demonstrate its transparency, lubricity, and stability. Phone your Stuart representative or the factory—BIshop 7-7100.

FREE SAMPLE



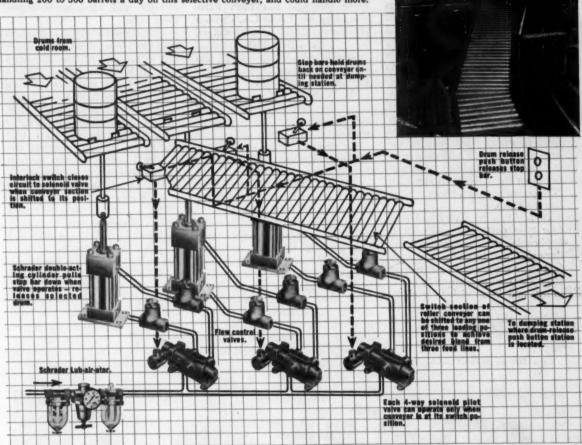
D. A. STUART OIL CO., LIMITED

2727 South Troy Street, Chicago 23, Illinois

CANADIAN D. A. STUART OIL CO., LTD. P.O. Box 430, 43 Upton Road, Scarborough, Ontario, Canada

Printed in U.S.A.

Processors automate even heavy work with air. In a complex frozen juice concentrate blending operation, Plymouth Citrus Products Cooperative, Plymouth, Fla., hooks up Schrader Air Products simply and economically to a gravity conveyor. Full 55-gal. barrels on feed sections roll down to stop bars and are selected in correct order and ratio for dumping. "The Schrader system performs well," says C. Byron Smith, plant manager. "We're handling 200 to 300 barrels a day on this selective conveyer, and could handle more."



# PROCESSOR AUTOMATES BACK-BREAKING CHORE WITH SCHRADER AIR PRODUCTS... GAINS SPEED, EFFICIENCY, BIG ECONOMIES

Solve difficult problems of handling, conveying and sorting, just like this company... with air! Versatile Schrader Air Products take punishing environments in stride, even corrosive atmospheres... Work together like magic on American production systems of many different kinds in hundreds of industries.

You already have air. Add Schrader Air Products to push, pull, hold, position, move work repetitively . . . cure headaches of weight, assembly, production maintenance . . . perform tirelessly and with precision. Speedy yet safe Schrader takes the drudge out of work, adopts to special needs, saves time, money and effort.

Select from the full Schrader lines to plan your automation of machines. Your Schrader distributor can help you pinpoint what you need. For more data write:



A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
454 Vanderbitt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

vious equipment. It has no moving parts, is noiseless, and can be moved about easily.

The aluminum electrodes, which have vastly increased the wear ratio, are one of the salient factors in the improved metal-removal rate of this equipment. Normal wear ratio approximates a 3 to 1 end wear whereas the aluminum electrodes have between 20 to 50 to 1 end wear.

In the rough-machining of contour or cavity type dies for forging or metal forming, machining may be completed at full metal-removal rates to within 0.060 inch of the final contour size. Finish machining is then easily completed by switching from the ER-300 to any Elox NPS power supply without moving the die setup.

In addition to cavity and contour type parts, the new unit is applicable to rough-machining through hole type die openings that are rough-sawed to shape; to large deep holes such as in cruciforms, and in special alloy materials. It is also now practical to eliminate the steps of layout and rough-drilling and sawing of larger blanking dies.

Circle 569 on Readers' Service Card

# **Oxweld Shape-Cutting Machine**

An Oxweld dual-carriage shapecutting machine made in three lengths and featuring a unique drive principle has been introduced by the Linde Co., division of Union Carbide Corporation. New York City. The patented "roller drive" of this CM-56 machine, Fig. 1, completely eliminates the drive wheel from the template table. With the new equipment, it is not necessary to provide protection for the template to prevent scuffing or damage to the outline being traced. There is no force tending to shift the position of the line drawing and it is easier to move and align the template. Drawings can be positioned without raising the tracing head.

A carriage running on the main rails carries another pair of rails that support the transverse carriage. With the combined motion of the two carriages, it is possible to follow and cut metal parts and forms of any shape. Either carriage can be locked, making it possible to produce perfectly straight and accurate cuts parallel to the main rails or at exactly 90 degrees to the main rails. This feature offers a

distinct advantage over singlecarriage, swinging-arm type machines which cannot readily make straight and accurate 90-degree cross cuts.

The Oxweld CM-56 requires only exact-size pencil or ink drawings to accurately reproduce metal parts. It is designed to carry more torches over a wider range than other similar-sized and even larger machines previously available. The CM-56 10-foot model carries up to eight torches; the CM-56 7 1/2-foot model, up to six torches, the CM-56 5-foot model, up to four torches. No special equipment is needed to add additional torches within the limits of the equipment.

The machine is equipped with Linde's photocell tracer, Fig. 2, with built-in kerf adjustment. Simple pencil or ink sketches of intricate metal shapes and forms are used to guide the torches. The photocell tracer accurately follows easily prepared sketches on ordinary paper, eliminating the need for metal or plastic templates, photographic negatives, or complicated and costly silhouettes. Wear on templates and cover

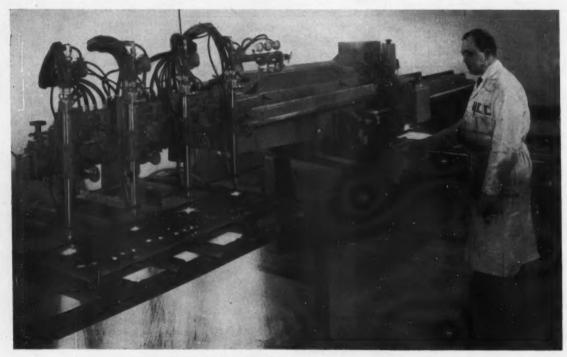


Fig. 1. Oxweld 90-inch model dual-carriage shape-cutting machine

# JONES & LAMSON MACHINE COMPANY

the man who needs

a new machine tool is

already paying for it

# NOW J&L CAN PUT A NEW \$20,000 MACHINE TOOL ON YOUR PAYROLL FOR \$2.50 PER HOUR

... with no capital outlay

... no purchase option or obligation

...and payable entirely out of "Profitivity"®!

The announcement of J & L's revolutionary Profitivity Leasing Plan made national news in February, and resulted in the leasing by industry of a substantial amount of new high-speed, high-profit J & L equipment within the first thirty days.

If your production requires metal-working processes, don't fail to investigate the PROFITIVITY LEASING PLAN®. It is the most important machine replacement development in our history as a top producer of machine tools. Send for our new lease folder. Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vt.

sheets is completely eliminated since neither the machine nor tracer ever comes in contact with the drawing or tracing surface. Tracing accuracy is held to plus or minus 0.005 inch.

Ordinary light, sunlight, or shadows do not interfere with the precision operation of the tracer. It can negotiate 90-degree turns with 1/16-inch radius at speeds up to 16 ipm and 90-degree turns with 1/8-inch radius at speeds up to 27 ipm. The operator can follow the cutting operation without fear of upsetting the cutting pattern. He can steer the torches manually or use remote control buttons to engage the template.

Preheat gases and cutting oxygen are controlled by solenoid valves large enough to assure an adequate gas supply for multipletorch operations. Each torch has an individual cutting-oxygen solenoid valve to assure instantaneous shut-off of gas, thus eliminating overrun at the end of a cut. Valves are controlled by electric switches on the control panel. In addition, each torch has individual valves for fine adjustment of the preheat gases and a shut-off valve for the cutting oxygen.

Motorized torch holders provide

automatic up and down adjustment of all torches. An automatic height-adjustment control is also available. This unit rides the plate in front of the torches and quickly senses the slightest deviation in levelness of the plate surface. The motorized torch holders react instantly, lowering or raising the torches to compensate for any deviation,

Circle 570 on Readers' Service Card

### Abrasive-Belt Head Unit for Contour Polishing

Divine Brothers Co., Utica, N. Y., has added an abrasive-belt head unit, called the "DLS," to its line of contour-polishing machinery. This unit is especially designed for this purpose, but is equally desirable for flat work. It performs both slack-belt operations and work requiring the backing-up of the abrasive belt with a contact wheel or platen.

Wide spacing between the two idler pulleys permits the polishing of sharply contoured work since the abrasive belt has more opportunity to retract itself. The unit is available with various controls, accessories, and alternate arrangements. A pressure regulator, gage, and quick-acting lever valve are included for control of the belt-tensioning air cylinder. The abrasive-belt length is 132 feet. Belt width and drive-motor are furnished to suit the application.

Circle 571 on Readers' Service Card

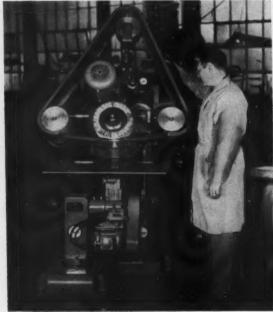
# Versatile Wales-Strippit "CI" Units

Wales-Strippit, Inc., Akron, N. Y., is introducing a Strippit Type CJ self-contained unit designed to punch both round and shaped holes. This unit will sell at the same price as ordinary round-hole units. The holders are metallurgically correct for their punching range and are provided with superior, more expensive one-piece shoulder head punches in both the round and shaped series. Type CI units include holders and die bases keyed to take shapes. To punch shaped holes all the buyer must do is substitute the proper shaped parts. Keying maintains positive, accurate alignment at all times. The unit can be converted to round-hole work in just a few

Circle 572 on Readers' Service Card (This section continued on page 210)



Fig. 2. New tracing system of Oxweld CM-56 machine shown in Fig. 1



Contour polishing machine announced by Divine Brothers Co.

# JONES & LAMSON OPTICAL COMPARATORS

the man who needs

a new machine tool is



# Now...an Economy-size Optical Comparator with "Big Machine" Features

Here is a fine optical inspection and measuring instrument of brand-new design. It is the first small-screen comparator to offer such BIG performance. It is equally suitable for production-line operation or job-shop work, and is extremely flexible in application.

The J&L TC-10 is of precision machine tool construction. This provides a solid base for precise inspection and measurement.

Three different table styles are available, including a fixed table for straight comparison work, a plain table, and a measuring table which gives you 6 square inches of measuring

area. All measurements are read directly to .0001", without computation.

Among other things, the TC-10 is adaptable for reflection inspection. Reflected images are extremely sharp—even at high magnifications. Other "big machine" features include Angle

Other "big machine" features include Angle Measuring; Quick-Change Lens Mount; Vertical Staging; Tracing Inspection. And there's a big bonus in the 5X, 2" aperture lens, which gives inspection capacity and accuracy hitherto unattainable on a machine of this size. Write for folder. Jones & Lamson Machine Company, 512 Clinton St., Springfield, Vt.

Turret Lathes . Automatic Lathes . Tape Controlled Machines . Thread a Form Grinders . Optical Comparators . This

### Cross Two-Station Shuttle Machine for Finishing Exhaust Manifolds

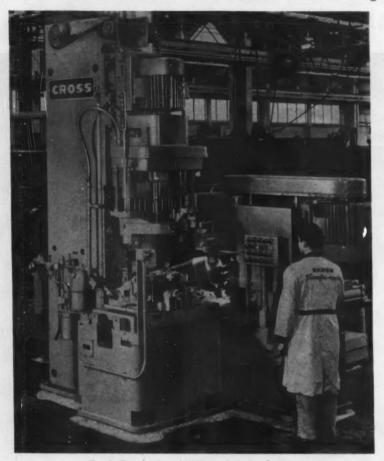


Fig. 1. Two-station shuttle machine for finishing exhaust manifolds, built by The Cross Co.

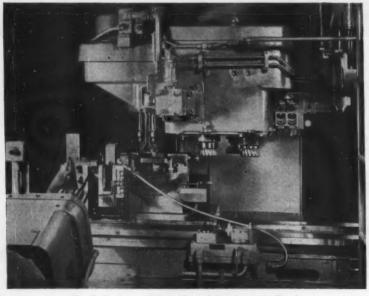


Fig. 2. Tool equipment of machine shown in Fig. 1

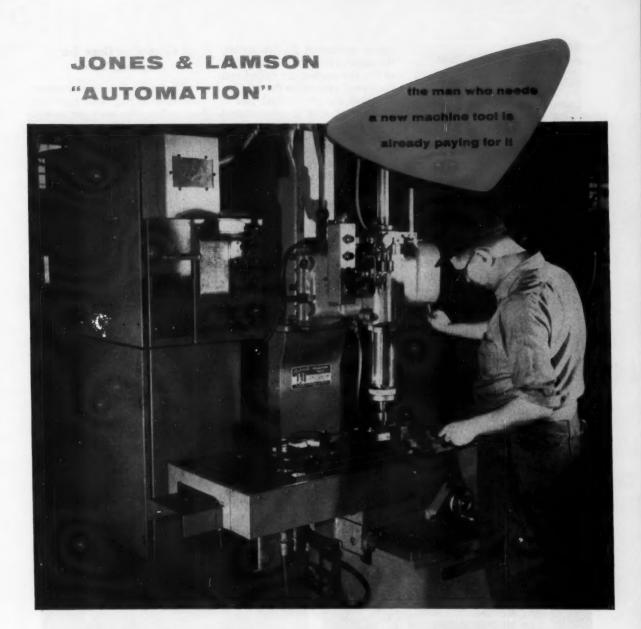
Exhaust manifold castings can be completely finished in a machine that not only saves floor space but can be made to meet part-design changes by simple alterations. This unit, Fig. 1, designed and built by The Cross Co., Detroit, Mich., mills all flange faces of manifolds while they are being transferred and performs machining operations in both stations. Any change of the tail-pipe flange angle of the manifoldwhich usually occurs with each new vehicle model-can be accommodated by changing the fixturing and the angle of just one head in one of the stations.

A two-position fixture, mounted on the shuttle, Fig. 2, is loaded with two parts in the first station. One raw casting, shown in the upper view, Fig. 3, is clamped with its four exhaust-port flanges up. A partially finished casting is turned end for end, rotated approximately 90 degrees, and clamped with the tail-pipe flange up. The fixture locates the unmachined parts on cast surfaces and will accommodate normal casting variations. The semifinished part is located by two milled surfaces and two drilled holes.

After the automatic cycle is initiated, the pallet moves to the second station. During the transfer, the parts pass under and are machined by three inserted-blade carbide-tipped milling cutters which may be seen in Fig. 2. The exhaust-port flanges pass under a roughing and a finishing cutter. Only one cutter is needed on the tail-pipe flange since finish requirements are not as rigid because the tail pipe fits into a machined opening, directing the hot gases away from the gasketed joint.

In the second station, the tailpipe flange holes of the raw casting are drilled by an angular head. The same holes in the semifinished part are tapped by tools mounted on the same short vertical column as the milling cutters, Fig. 2. With normal part-design changes, it would only be necessary to change the angle of the tail-pipe flangedrilling head. Because of standard component design, this is a comparatively simple matter.

(Continued on page 212)



# Major savings on every job during first full year of tape control operation

At The Goss Company, a division of Miehle-Goss-Dexter, Inc., Chicago, tape control machining plays an important part in the over-all

production operation.

For instance, this J & L tape-controlled positioning table, equipped with a standard column drill press, has achieved an average of 30 to 40% savings in floor-to-floor time on every job assigned. One job, involving drilling and reaming of small malleable iron transfer roll adjusting plates, was transferred from a conventional sensitive drill press setup to the J&L machine. Job lots consisted of only four

The old setup required 3.1 hours production

time for each lot. Using tape control, with a simple locating and clamping setup, Goss has been able to cut this time to 1.7 hours—a saving of 1.4 hours per lot, or more than 45%. Hole location is more accurate too, because J & L tape control consistently holds tolerances of + or - .001". With the old setup, it was difficult to hold hole locations to less than .010" on layout jobs of this size.

Investigate how production-proven tape control units can help increase the efficiency of your operation. Write to Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont for folder 5902, "Tape Control Positioning".

Turret Lathes Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



Fig. 3. (Top) Raw exhaust manifold casting. (Bottom) Finished manifold

The parts are shuttled back to the first station in rapid traverse for the final machining operations. To prevent scuffing of the milled surfaces, the milling cutters are lifted about 1/8 inch during the return movement. In this station. the eight exhaust-port flange holes of the raw casting are drilled and the central opening in the tail-pipe flange of the semifinished part is finished with a two-step boring tool using carbide cutters. At the end of this automatic cycle, the operator removes the finished part, transfers the semifinished part to the second fixture position, and inserts a raw part in the first position. Each back-and-forth cycle of the machine shuttle produces one finished manifold. The production rate is twenty parts per hour at 100 per cent efficiency while producing truck manifolds like the one shown in the lower view, Fig. 3.

Circle 573 on Readers' Service Card

# Unique Bending Brake Introduced by Lake Erie Machinery Corporation

"Form-All" is the name of a new principle incorporated in bending brakes introduced at the tool show by the Lake Erie Machinery Corporation, Buffalo, N. Y. This bending brake makes it possible to turn out intricate shapes quickly and accurately without dies or tooling. It produces combinations of bends and one-piece parts said to be impossible to duplicate by any other standard method. Typical examples are narrow-webbed deep channels, closed rectangular tubes, etc.

For angle bending from 0 to 155

degrees, a pair of wings pivot about a point off the tip of a holding blade. For radius bending, the wings travel along a curve of the desired radius. Form-All brakes are available in a wide variety of sizes and in hand-, air-, and hydraulically powered models. The model 414-C Form-All bending brake illustrated is equipped for intricate angle bending and radius forming. It has a 4-foot by 14-gage capacity and is provided with hand clamp and air-operated wings.

Circle 574 on Readers' Service Card

# Centering Gage for Cutting Tool

A fast and extremely accurate method of setting lathe type cutting tools to the work center line is made possible by a gage manufactured by the Tru-Center Products Co., Decatur, Ill. The machined aluminum body of the gage is attached to the cylindrical workpiece by ceramic magnets in the gage body. If the work-piece is of nonmagnetic material, such as aluminum or brass, the gage is held in place by a rubber band.

Spirit levels enable the gage to be positioned to a degree of accuracy which can be measured in increments of 0.0001 inch, thus enabling the lathe tool to be positioned either on the exact center line or to a known amount above or below the center line. Imbedded in the forward edge of the gage is a wear pad (anvil) which rests on top of the cutting edge of the tool so that actual machining must take place at the exact point indicated by the gage. A chart is furnished which translates the spirit-level graduations into 0.001 inch, either above or below the center line.

Being light in weight and ruggedly constructed, the Tru-Center gage has many uses, including right-angle measuring and leveling.

Circle 575 on Readers' Service Card

(This section continued on page 214)



Lake Erie Form-All bending brake

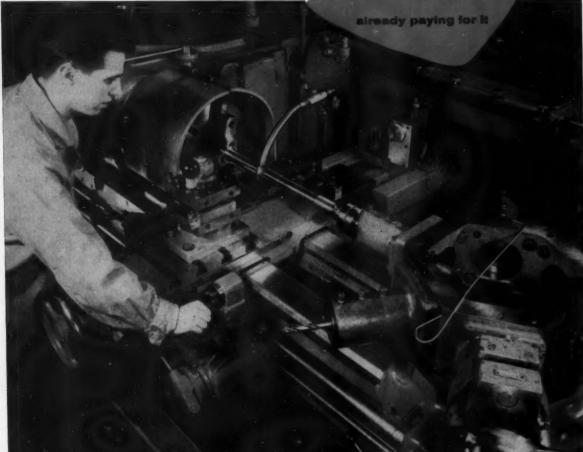


Tru-Center gage for centering lathe tool



the man who needs

a new machine tool is



### Two-dimension tracing eliminates secondary operations and reduces costly "off" machine time

Two-dimension tracing, combined with conventional turret lathe tooling, provides an extremely versatile method for complete machining to tight specifications.

For instance, the end use of the connecting rod bolt (illustrated above) demands extremely fine finish to eliminate the starting of fatigue cracks. In addition, relief surfaces, O.D., head faces, and threaded end must all be square and concentric. Radii of fillets connecting the different diameters must be smooth and free from scratches. Two reliefs, each  $6\frac{1}{2}$ " in length, must be held to + or

— .002" and to 40-50 RMS to eliminate subsequent grinding operations. The finished parts are 19-3/4" long with different O.D.'s varying from 1-1/2" to 2-7/16". The material is tough: AISI 4140; Brinell 241.

All this is accomplished in one tooling set-up on a J&L turret lathe with a two-dimensional tracer. Floor-to-floor time for finished parts is less than three minutes on the head end, and less than nine minutes on the shank end. Write for Folder #5903.

Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

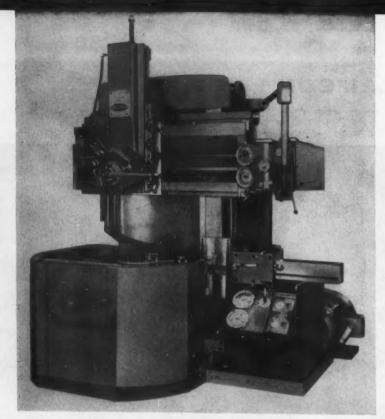


Fig. 1. Bullard 36-inch Dynatrol lathe with Size-Au-Trol on turret side-heads

### Vertical Turret Lathes Equipped with "Size-Au-Trol"

"Size-Au-Trol," a new concept in machine tool control developed by the Bullard Co., Bridgeport, Conn., is being incorporated as a standard feature in all Bullard "Dynatrol" vertical turnet lathes (Fig. 1). This control is designed to bring the cutting heads automatically to a

NETRUCTIONS TOR STEVENS BAIN HEAC DESIGNED DISCS

- Management and the stevens and the stevens

stop when they reach preset positions during each successive stage of the machining operation, thus relieving the operator of responsibility for sizing the work.

The Size-Au-Trol is said to provide precise control over both horizontal and vertical motions of the heads so that uniformity in the finished dimensions of the parts is assured. After the initial setup, repetitive accuracy of head positioning to limits of 0.0003 inch in either axis is positively assured.

The control can be applied effectively to regulate internal boring as well as external turning, and to control both internal and external facing.

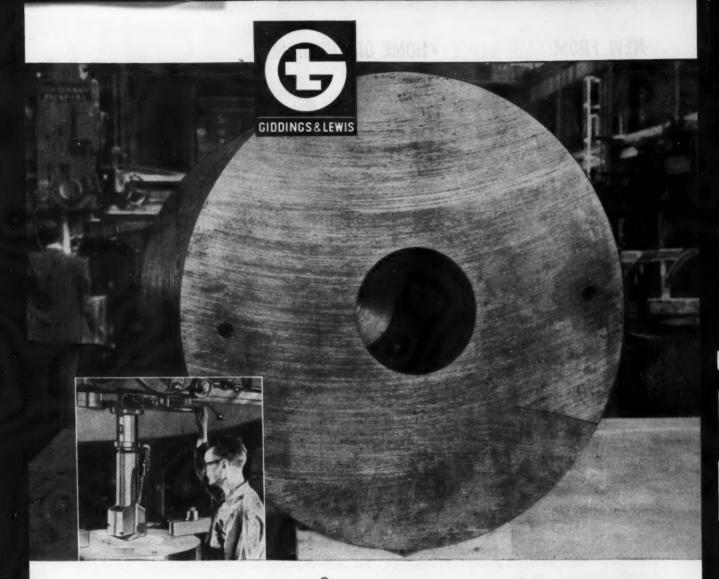
Size-Au-Trol is operated by a system of electromechanical devices that provide a positive linkage between the control system and the rapid traverse and feed drive to the turret and other cutting heads. This system uses rotating drums made up of adjustable discs—one for each positioning function. The discs provide the means for making contact with a series of corresponding switches which operate a solenoid valve to engage or disengage the clutches that apply power to the horizontal and vertical feed-screws.

A separate Size-Au-Trol unit is provided for each head. Each unit is contained in a compact housing mounted on the feed bracket. The unit contains four horizontal drums (Fig. 2) arranged in two pairs mounted one above the other. One pair of drums controls the horizontal motions, the other, the vertical. Each pair consists of a coarse and a fine detector drum. The fine detector drums are geared directly to the respective feed-screws; the coarse detector drum in each pair is driven from its respective fine detector drum by worm gearing.

Each drum carries a number of detector discs—twenty on each drum is standard, but more can be added, up to a total of forty per drum. These discs are simple, flat, circular plates, each with a single cam which makes contact with the

(Continued on page 218)

Fig. 2. Coarse and fine detector drums that control horizontal and vertical head motions to preset positions on machine shown in Fig. 1



### G&L Chipmaster radial drives 8" spade drill in solid steel forging!



### **ALL-NEW CHIPMASTER**

the heavy-duty radial that does more than any before.

New G&L/Bickford Chipmaster radial drills have capabilities not approached by any other radial. The job above is a good example. An 8" diameter hole, 18%" deep, is spade drilled in solid SAE 4145 forged steel with a Brinell hardness of 200-240. The workpiece is a rolling mill drive coupling produced at Frank Kneeland Plant, United Engineering & Foundry Co., Pittsburgh. The machine is a 6'-19" Chipmaster radial with a 25-hp motor.

The power, rigidity, and thrust capacity that enable the Chipmaster to handle this job will pay big dividends on any job. It means that you have the capacity to handle heavy drilling, boring, reaming, facing, trepanning, and spade drilling jobs. It means precision, accuracy, and maximum production. The Chipmaster can handle jobs now being done on slower or more costly machines.

For all the facts, call your G&L/Bickford distributor.

### GIDDINGS & LEWIS MACHINE TOOL COMPANY

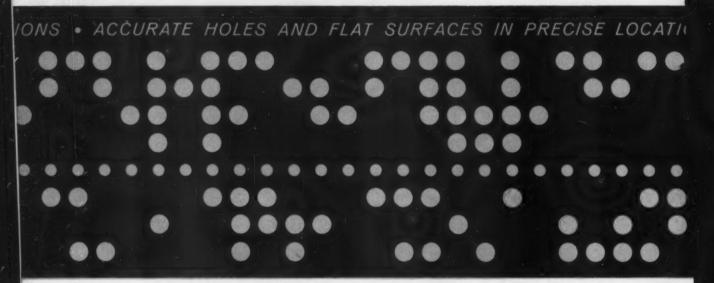
### FOND DU LAC, WISCONSIN . EST. 1859

Giddings & Lewis also manufactures: vertical and horizontal boring machines, vertical turret lathes, planers, planer mills, contour milling machines, die sinking machines, drilling machines, numerical and tracer control systems, boring tools and related items, and machine tool accessories.

NEW FROM FAIR STREET . HOME OF THE JIGMIL

# tapac

tape control system for DeVlieg Spiramatic Jigmils®



Now available for automatic programming of all Spiramatic Jigmils, Tapac is DeVlieg's own system of numerical control. And it is so simplified, a tool engineer can master the programming technique in 3 to 4 hours.

Designed to make full use of JIGMIL'S inherent accuracy and precision, Tapac is a point-to-point system for automatic measuring, positioning and cycling complete parts programs utilizing 1" eight-channel standard punched tape input. Automatic functions include sequential or simultaneous positioning of vertical and horizontal slides, spindle depth control cycling and control of spindle speeds and feeds. Automatic positioning repeats to within 0.0001". The control system is comprised of simple plug-in electronics and standard proven components.

Come to Fair Street and see the Tapac system of automatic tape control for jigless boring and machining in our own production operations. Its accuracy, precision and flexibility will work equally well for you.

\*Trademark-De Vlieg Machine Company

Rewarding revelations in automatic



precision await your next visit to Fair Street

### DeVlieg

SPIRAMATIC JIGMILS®

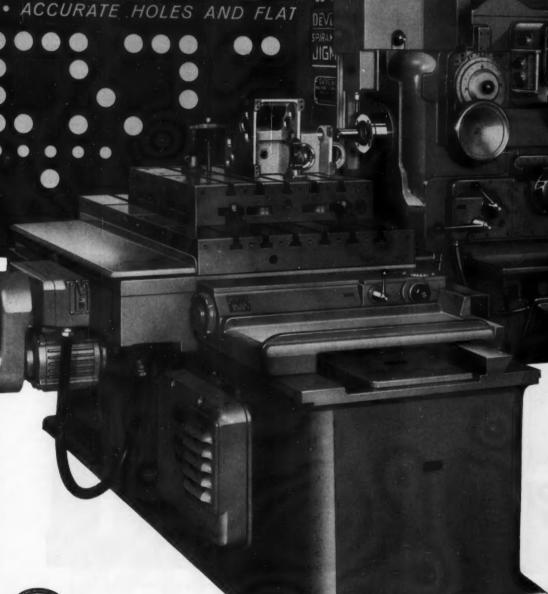
ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

DE VLIEG MACHINE COMPANY, FAIR STREET

ROYAL OAK, MICHIGAN



ACCURATE HOLES AND FLAT



3B-4



BOOTH 431 NMTBA EXPOSITION

matching switch as the drum rotates. The exact position of the cam on each disc with respect to the perimeter of the drum can be adjusted by rotating the disc. The discs are spring-loaded and firmly held by friction in the set positions.

As the drum rotates, the cams make contact with a corresponding series of switches. The contact actuates a solenoid valve, exhausting the hydraulic pressure which has engaged the directional clutch, and thus disengages the feed-screw. This stops that particular directional motion of the head. Two additional discs on the drum of each pair serve as limit stops for head travel. On the front of the unit are two selector switches (one each for the horizontal and vertical motions) which have two positions -"index" and "repeat." There are also two function-indicator dials (one for each axis) which are numbered to correspond with the numbers of the detector discs. One revolution of the fine drum corresponds to 1 inch of head travel; one revolution of the coarse drum corresponds to 100 inches of head travel. (0.001 inch of head travel corresponds to 0.012 inch rotation of the fine drum.)

A release push-button on the cover—which is used only after the drum has been set up and when the selector switch is in the "repeat" position—engages the directional clutches.

After completing a setup, the operator resets the function indicator dials to the No. 1 position, turns the selector switches from "repeat" to "index" and is ready to start machining. The movements of the heads are engaged manually in

the proper direction by means of the single-lever control. When the head (i.e., the cutting tool) reaches the preset position, Size-Au-Trol stops its movement automatically. A stepping relay indexes the drum to the next function and the operator then manually engages the proper traverse or feed for the next movement of the head; Size-Au-Trol again takes over. To compensate for tool wear, provision is made for the operator to override Size-Au-Trol in order to make manual adjustments.

Circle 576 on Readers' Service Card

### Special Double-End Rotary Turret Machine for Processing Gas-Meter Bodies

The Michigan Special Machine Co., Warren, Mich., has designed and built a special, giant-size unit for universal double-end drilling, reaming, tapping, boring, chamfering, and spot-facing thirteen different sizes and styles of commercial gas-meter bodies, with an output of ten parts per hour. This equipment, Fig. 1, handles both cast-iron and aluminum commer-

cial gas-meter bodies. It has 183 spindles, all of which are interchangeable. Some of the spindles, in turn, have multiple-spindle heads, in clusters of three, operated from a single splined take-off. The parts are locked into position once for complete cycling and are moved to the cutting tools instead of moving the tools to the part.

(Continued on page 224)

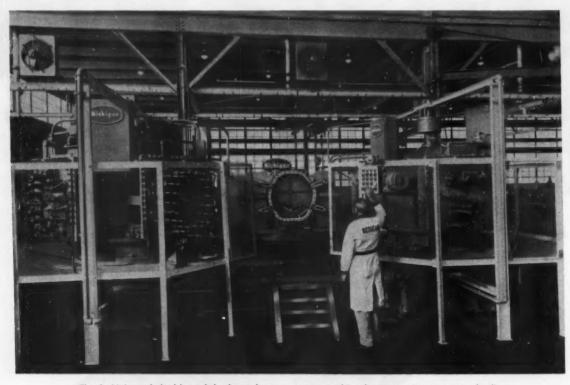


Fig. 1. Universal double-end, horizontal, rotary turret machine for processing gas-meter bodies built by Michigan Special Machine Co.



Lindner LB14 Jig Borer at Philips Electronics, Inc., Mount Vernon, N. Y., has 32" x 16" table. Also available in larger model, LB15A with Autopositioner®—Table 44" x 24".



Precision Production—Boring 20 holes in the specimen plate cover of the Norelco Model 100KV Spectrograph. Done in one set-up. Times 2 hours, 30% faster than previous methods!



Precision Tooling—Boring holes in a drill jig for the Norelco Powder Camera. Opposite holes must be aligned within .0001".

### How the Lindner Optical Measuring System brings greater precision to jig boring

at Philips Electronics, Inc.

A jig borer can be no more accurate than its measuring system. And in the Lindner the problem of maintaining permanent accuracy has been solved by the machine's unique fully optical measuring system.

No lead screws. No gage blocks. No bars or limit switches. The helically scribed, cylindrical measuring scales in every Lindner are touched by a light beam only. These scales are independent of the table movement mechanism and immovable in axial direction. Thus, the whole system is permanently protected against any mechanical wear whatsoever. Lifetime accuracy!

Visual fatigue and errors in settings are minimized by a photo-electric centering device. It makes possible initial and repeat settings guaranteed accurate within .00015" over the full length of travel and readings in .00005".

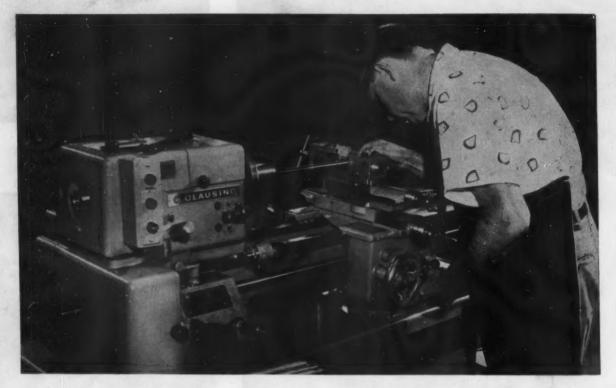
There's no eye strain or bending. A helical line from the measuring scale is projected onto a  $2\frac{1}{2}$ " wide screen which the operator reads from a standing position. No eyepiece required.

That's why Philips Electronics—like so many other precision producers—relies on the Lindner for tooling, production and inspection of its Norelco atom measuring equipment and other precision research tools.

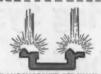
The Lindner optical measuring system is changing ideas about jig boring all over the country. We've packed all the facts into a meaty 25-minute movie film. Send for it today without obligation. Or write for literature.



42 Exchange Place, Jersey City 2, New Jersey



### "For stamina, ease of operation, and ability to repeat to close tolerance Clausing 12%" lathes lead their fields"



FLAME HARDENED BED WAYS — a long-service-life feature that is standard equipment at ne extra



TIMKEN "ZERO-PRECISION"
TAPERED ROLLER BEARINGS
assure precision performance
and long accuracy life.



UNDERNEATH DRIVE with choice of variable speed countershaft or 10-speed countershaft, with

This statement, by FREQUENCY STANDARDS of New Shrewsbury, New Jersey, is typical of user reports on CLAUSING 5400-Series lathes. And no wonder, no lathes at or near CLAUSING'S low prices give you so many QUALITY features. Here are just a few of them:

- SHAVED GEARS . . . an exclusive that assures greater accuracy.
- FLAME HARDENED, PRECISION GROUND BED WAYS STANDARD EQUIPMENT... a feature that costs many dollars more with other lathes in this class.
- BIG FORGED STEEL SPINDLE WITH HARDENED GROUND NOSE . . . 1 1/8" bore . . . 1" collet capacity.
- TIMKEN "ZERO PRECISION" TAPERED ROLLER BEAR-INGS.
- CHOICE OF VARIABLE-SPEED OR 10-SPEED BALL BEARING COUNTERSHAFT... with clutch and brake optional.
- VERIFIED ACCURACY . . . factory test report accompanies each lathe.

Get all the facts and compare. When you have, we are confident you, too, will agree that "for stamina, ease of operation, ability to repeat to close tolerance and all around value, CLAUSING 5400-Series lathes lead their field by a wide margin." Write, today, for complete information.

PRICES START AT \$1120 F.O.B. FACTORY

### CLAUSING DIVISIO

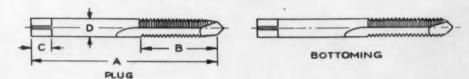
-108 N. PITCHER ST. . KALAMAZOO, MICH.



### AMERICAN STANDARD CUT AND GROUND THREAD TAPS-13

### **Spiral-Pointed Machine Screw Taps**

Carbon Steel—Cut Thread High-Speed Steel—Cut Thread High-Speed Steel-Ground Thread



### General Dimensions

	Basic .		T	hreads	per Inc	ch		Num-		D	imen sion s		
Size	Major Diam-	Ca	rbon St	eel	High	-Speed	Steel	ber of	Length Overall	Length	Length	Diam- eter of	Size
	eter	NC UNC	NF UNF	NS	NC UNC	NF UNF	NS	Flutes	A	Thread B	Square	Shank D	Square
0.	0.060					80		2	1 %	%	3/16	0.141	0.110
1	0.073				64	72		2	1 11/16	3/6	3/18	0.141	0.110
2	0.086				56	64		2	1 3/4	1/10	3/16	0.141	0.110
3	0.099	48	56		48	56		2	1 13/16	1/2	3/16	0.141	0.110
4	0.112	40	48	36	40	48	36	2	1 %	%	3/20	0.141	0.110
5	0.125	40	.44		40	44		2	1 19/16	3/6	3/16	0.141	0.110
6	0.138	32	40		32	40		2	2	11/16	3/10	0.141	0.110
8	0.164	32	36		32	36		2	2 1/4	3/4	1/4	0.168	0.131
10	0.190	24	32		24	32		2	2 %	3/4	1/4	0.194	0.152
12	0.216	24	28		24	28		2	2 %	15/16	%3	0.220	0.165
14	0.242			20,24			20,24	2 .	2 1/2	1	1/2	0.255	0.191

Carbon and high speed steel cut thread taps are furnished in plug style in sizes 3 to 14, inclusive.

Ground thread taps are furnished in plug or bottoming style in sizes 0 to 14, inclusive, except that taps with NS threads are furnished in plug style only.

All taps have external center on thread end.

### Tolerances\*

	-	n: .	Tolerance		
Element	Kange	Range Direction		Ground Thread	
Length Overall (A)	0 to 14 incl.	Plus or Minus	1/32	2/32	
Length of Thread (B)	0 to 12 incl. 14	Plus or Minus Plus or Minus	3/64	3/64 1/16	
Length of Square (C)	0 to 14 incl.	Plus or Minus	1/32	1/32	
Diameter of Shank (D)	0 to 12 incl.	Minus Minus	0.004	0.0015	
Size of Square (E)	0 to 14 incl.	Minus	0.004	0.004	

All dimensions are given in inches.

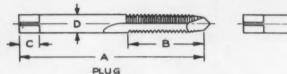
 $^{\circ}\mathrm{For}$  eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet published in February, 1960, page 186.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y.

### AMERICAN STANDARD CUT AND GROUND THREAD TAPS-14

### Spiral-Pointed Machine Screw Taps

### Oversize High-Speed Steel-Ground Thread





### General Dimensions

		met -		N		I	Dimension	S		
Size	Basic Major Diameter	Threads per Inch		Number of Flutes	Length Overall					
		NC UNC	NF UNF	Standard	Λ	B	C D	Square E		
6 8 10	0.138 0.164 0.190	32 32 24	32	2 2 2	2 2 1/4 2 1/4	31/ <sub>66</sub> 3/ <sub>4</sub> 3/ <sub>6</sub>	3/16 3/4 1/4	0.141 0.168 0.194	0.110 0.131 0.152	

All dimensions are given in inches. These taps are furnished in plug or bottoming style only. Oversize taps are made  $.002^{11}$  larger than the H3 limits shown in Table 329. All taps have external center on thread end,

### Tolerances\*

Element		Range	Direction	Tolerance	
Length Overall Length of Thread Length of Square Diameter of Shank Size of Square	(C)	6 to 10 incl.	plus or minus plus or minus plus or minus minus minus	1/32 3/64 1/32 0.0015 0.004	

All dimensions are given in inches.

\*For eccentricity tolerances of tap elements, see table in MACHINERY'S Data Sheet published in February, 1960, page 186.

Extracted from American Standard Taps—Cut and Ground Threads (ASA B5.4-1959), with the permission of the publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

WEAR RESISTANT THOMSON

600

and difficulty of fabricating long, hard & straight parts by conventional methods!

# nardened and ground

SHAFTS, ROLLS, GUIDE RODS and other long-round parts

ELIMINATE WEAR and REDUCE COST

of over 15 years of experimental work and production experience with hardened and ground shafts which are a requirement for BALL BUSHINGS, the Linear Ball Bearing manufactured by Thomson Industries, Inc.

The special techniques and equipment that have been developed enable high production rates and low handling costs. This permits big savings over conventional methods which are plagued with erratic warpage, straightening and resultant grinding problems. Finished 60 Case parts frequently cost less than the scrap losses that result from conventional methods.

60 Case material has a surface hardness close to 60 on the Rockwell C scale which is essential to resist wear.

Long lengths of material ranging in diameter from ¼" to 4" are stocked to enable prompt shipment of 60 Case parts, with or without special machining. Write for literature and name of your local representative.

For emergency needs call collect MAnhasset 7-1800

### ADVANTAGES of 60 Case

- . COST REDUCTION
- . GROUND FINISH
- . HARD BEARING SURFACE
- STRAIGHT PARTS
- NICK-& DENT-PROOF
   ACCURATE DIAMETERS
- DELIVERY FROM STOCK
   ADDED STRENGTH
- . UNIFORM HIGH QUALITY

### TYPICAL 60 Case PARTS

GUIDE RODS • SHAFTING • ROLLS • TRAVERSE RAILS PISTON RODS • ARBORS • LEADER PINS • TIE RODS KING PINS • AXLES • CONTROL RODS • GUIDE POSTS MANDRELS • BEARING ROLLERS • SPINDLES

### THOMSON INDUSTRIES

Inc.

Dept. C-9, Manhasset, New York

PARTS HARDENED to 60 C...

increase life ... reduce cost!

The machine is automatic, except for loading and unloading. It is built to JIC hydraulic and electrical standards. All moving parts are automatically lubricated, and a coolant is supplied to all spindles. All drilling spindles (see top view, Fig. 2) are of ball-bearing construction and are interchangeable, with any number of plate patterns. These are so designed that they allow for an infinite number of hole patterns. All tapping spindles (see lower view, Fig. 2) are of ballbearing and lead-screw construction. Likewise, these spindles are interchangeable and have universal-joint type drives that permit a greater degree of interchangeability and a wider positioning range.

All spindle plates are prebored for position in order to cut down the change-over time. This also assures close accuracy of all holes. All tools are preset on spindle plates outside the machine.

As shown diagrammatically in Fig. 3, this special machine has two hydraulic index-tables, mounted at opposite ends of the base—a four-station index-table at the left, and a two-station index-table at the right. Between these two

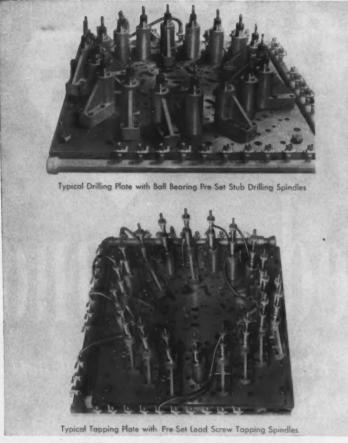


Fig. 2. Drilling and tapping plates with preset spindles such as used on machine shown in Fig. 1

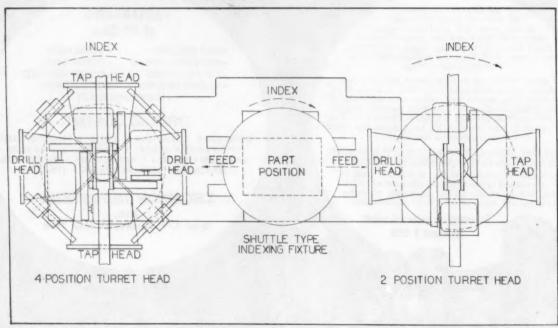
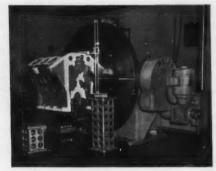


Fig. 3. Diagrammatic plan view of Michigan machine shown in Fig. 1



# Dimensional check on 7 planes in one set-up!





Yes... every angle, diameter, straight line, every critical surface, on seven different planes of a V-type block, completely accurately checked without disturbing the initial set-up! How is it possible? With Machine Products' ROTAB universal rotary positioning table, that's how.

And consider the advantages. Previously, this same operation required two men, who had to "wrestle" the block into seven separate set-ups... each time re-establishing the locating point. With ROTAB the V-block is loaded on the horizontally positioned table, locating point determined, block clamped in place. Then, ROTAB's precision, movable graduated ring is set at zero to start the angular or radial check, and one man, using motor-powered, push button tilting and rotation runs the entire inspection, saving up to 50% in time, increasing accuracy, reducing rejects.

This, briefly, is what ROTAB has accomplished for one of the nation's leading diesel engine manufacturers.

ROTAB, with its unlimited applications, can do wonders for you, too.

Write today for your catalog!

MACHINE PRODUCTS Corporation
6771 E. McNichols ROAD + DETROIT 12, MICHIGAN

8771 E. MENICHOLS ROAD . DETROIT 12, MICHIGAN

tables is a special No. HH-30 horizontal feed unit. On the platen of this unit is mounted a three-station hydraulic index-table, with hydraulically actuated hold-down clamps. This center index-table supports either one of two singleplace, work-holding fixtures, which are provided with the machine. The four-station index-table (on the left) supports four adjustable, multiple-spindle heads-two for drilling and two for tapping. The two-station index-table (on the right) supports two adjustable spindle heads-one drill head and one tap head.

The machine is surrounded where necessary by a protective wire screen, which is easily removed to permit servicing. At the load position, two hinged, interlocked gates are provided. To insure the utmost safety for the operator, the machine will not operate unless the gates are closed and locked. Provision is made for two major setups: one for machining the side cover faces, and the second, for machining the top cover face of all the gas-meter bodies.

The part is loaded in the front of the center index-table, on which is mounted a fixture. The part must be loaded into the fixture at a height suitable for clearing the bushing bracket for the flag rod tool-holder. The operator hand clamps the part in position, closes and locks the gate, and selects the cycle. The cycle that the selector switch should be set to, in each case, will depend upon which one of the thirteen styles and sizes of meter bodies is to be processedand the particular face about to be machined.

The part indexes 90 degrees. The number-one head on the left-side turret moves into position. Next, the table on which the part is mounted moves into the drills—in rapid feed—then moves forward at the required drilling feed. The part then withdraws far enough to permit indexing of the table (on the left side), which presents another group of drills. Then the drilling cycle is repeated.

The next index presents the tapping spindles for the first group of taps. Another index presents the tapping spindles for the second group of taps. After withdrawing

from the second group, the part indexes 180 degrees and presents its face to the two-position turret on the right side of the machine. This turret performs the drilling, tapping, boring, and chamfering operations in the same manner as for the left side of the machine. Upon completion, the part withdraws, then indexes automatically to face the operator for unloading. Each part is completed in one cycle of the machine. The fixtures will return to the load station and reposition themselves for unloading. The operator unclamps and unloads the part,

Circle 577 on Readers' Service Card

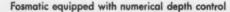
### Fosdick Precision Boring Machines with Numerical Depth Control

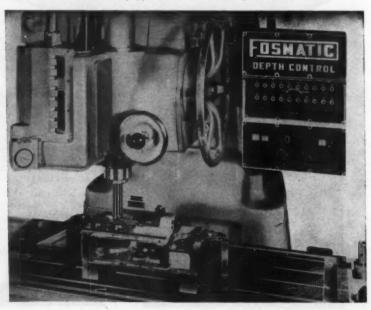
Numerical depth control is the latest optional feature available on Models 44 and 54 Fosmatic precision boring machines built by Fosdick Machine Tool Co., Cincinnati, Ohio. This feature adds the third automatically controlled dimension to precision boring. Equipped with Fosmatic numerical positioning (x and y axes) and depth (z axis) control, Fosmatic Models 44 and 54 become production machines of great versatility. They will be used especially for small-lot boring jobs requiring accuracy up to plus or minus 0.0001 inch. All control hardware and circuitry is mounted on the machine and within the standard Fosmatic numerical-control console. No extra cabinets are needed and floorspace requirements are unchanged.

Accurate depth programming is exceptionally easy with the Fos-

matic system because it is necessary to know the tool length only to the nearest 1/2 inch. Tool compensation takes only about one minute per tool, and is performed only once, to a zero reference. A "tool compensator" is mounted on the machine head. The same system is also used to adjust for tool wear. These numerically controlled machines accomplish automatic depth measurement by the use of a fully enclosed Class-A gage train similar in principle to that employed for automatic gaging and positioning on the Fos-matic table. Gages are mechanically aligned by an electric drive. Manual depth setting is accomplished by a series of direct-reading dials which mechanically stack the gages.

Whether under manual pushbutton control or tape control, the







### **CLEVELANDS**

automatically set the pace for progress!

Whitin Machine Works, Whitinsville, Mass., builders of textile preparatory machinery and other products, in part of a \$4½ million expansion program, has created one of the outstanding screw machine departments in the East. Sixteen new Cleveland Single Spindle Automatics (14, Model AB 3" Dialmatics and 2, Cleveland 4½" Model AW's) are among the facilities that are automatically setting the pace for progress at Whitin Machine Works.

William Steele, Divisional Superintendent, and Eino Johnson, Department Foreman, describe this ultra-modern installation as "one that few companies anywhere can equal. Our machine tool investment includes highly versatile Cleveland Automatics, many with electronic controls, that make possible higher production with still closer tolerances . . in many instances to 0.0005". As has been wisely said, 'you cannot build today's products with yesterday's machines, and still be in business tomorrow'."

Let Clevelands automatically set the pace for progress in your plant. Call in a Cleveland Automatic sales engineer.

Sales Offices: Chicago . Cleveland . Detroit . Hartford . Springfield, N. J.

### CLEVELAND

### **AUTOMATIC MACHINE COMPANY**

4936 Beech Street . Cincinnati 12, Ohio

\* Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

tool in one of these machines equipped with numerical depth control moves at a rapid approach rate to within 0.050 inch of the work surface, then changes automatically to the required feed rate. The result is a hole of exceptional accuracy and finish bored to the

specified depth.

Elements added to the basic Fosmatic numerical-control system to accomplish depth control are: (1) Depth Memory-Telephone type mechanical cross-bar switch and latching relays, all plug-in and quickly replaceable, mounted inside console. (2) Visual Read-out-Dimensions stored in memory and operation number appear on console face. (3) Tool Compensator-Mounted on right side of head. Can accommodate up to 100 different tool settings at one time. (4) Depth Gage Unit-Mounted on left side of head. Includes direct dimension dials for read-out. (5) New Circuits-Wired with benchmade aircraft type harness, fully coded to make circuit tracing easy. Wiring carried up the column of the machine in a covered raceway is fully accessible. Cable connections are of plug-in type.

Circle 578 on Readers' Service Card

### **Straightening Press**

A 200-ton hydraulic C-frame straightening press constructed of heavy welded sections, stress-relieved to provide maximum resistance to deflection under load, has been announced by the Farrel-Birmingham Co., Inc., Watson-Stillman Press Division, Rochester, N. Y. The press table is a steel weldment, machined to present a smooth pressing surface. Hydraulic pressure is provided by a vane type pump connected by a flexible coupling to a 10-hp electric motor. The motor has a speed of 1200 rpm and is complete with a starter and push-button station which operates on 440-volt, three-phase, 60-cycle current.

The press is controlled by a hand lever connected to a four-way valve which governs the direction of the oil flow between the pump and the cylinder. This provides the operator with a sensitive, quickacting control of the ram move-

monte

The press has a stroke of 18 inches, daylight opening of 18 inches, gap of 72 inches, ram pressing surface 24 by 6 inches, and an operating pressure of 2000 psi.

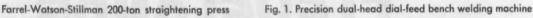
The advance speed is 250 ipm, the press speed, 8 ipm, and the return speed, 86 ipm. Over-all dimensions of the press are: width, 6 feet, depth 15 feet 8 inches, and height, 15 feet.

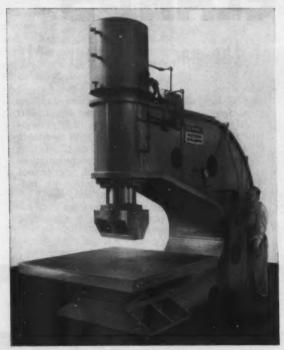
Circle 579 on Readers' Service Card

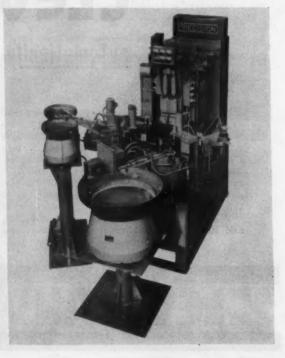
### Dual-Head, Dial-Feed Welding Machines

A line of precision dual-head, AVB-3 dial-feed, bench welding machines is being built by Precision Welder & Flexopress Corporation, Cincinnati, Ohio. The machines in this new line have been designed for mass-production welding of small parts. They are particularly suited to the highspeed assembly of small electrical components. Figs. 1 and 2 show AVB-3 machines tooled for welding parts for typical electrical outlets. The machine shown in the over-all view, Fig. 1, has a six-station Geneva dial-feed mechanism, three vibratory hopper-feed units, and an automatic ejector mechanism. It simultaneously projectionwelds support ears to the ends of two styles of yokes for a duplex electrical outlet at a production

THE RESIDENCE AND DESCRIPTION AND









### Evaluate this significant development in precision welding

Welds exotic metals. Facilitates the use of exotic metals for rockets, missiles and supersonic aircraft. Metallurgists point out that these metals offer better strength-to-weight ratios; more corrosion and heat resistance; superior fatigue, shock and stress characteristics. The machine handles stainless steel easily, producing T sections 60/1,000ths of an inch thick from sheet stock at seven feet per minute with practically no distortion.

Reliability, versatility. The flexibility offered by the design of the machine, and the precise focusing of the electron beam permit welding of complex shapes in hard-to-weld metals. Since the welding is performed in a vacuum chamber with pressure of 10-4 mm Hg., an atmospheric purity is provided which cannot be achieved under the best lab conditions with argon or helium shielding. Thus, contamination is virtually eliminated.

This Electron Beam equipment is also available as a cutting machine which permits extermely fine cuts to extremely close tolerances in any metallic or non-metallic equipment.



ONE-PASS weld in 0.400-inthick stainless steel. No filler metal was added.



WRITE TODAY for our detailed brochure and specifications on the Electron Beam Welding Machine... or the Cutting Machine. See how these extraordinary machines can improve your production techniques.



rate of from 1500 to 1700 parts per hour.

The close-up, Fig. 2, shows the six-station Geneva dial-feed table of a similar machine tooled for welding spring contacts to two different styles of yokes for electrical outlets, one of which requires a forming operation (forming head is at left). The springs are series welded to the yokes by dual, adjustable, air-operated welding heads, mechanically interlocked and balanced. Parts are fed and ejected automatically. Production is at the rate of 1500 to 1700 parts per hour.

The same basic AVB-3 machines can be equipped with tooling to satisfy forming, assembling, and fastening requirements for a tremendous variety of parts in many industries. The models pictured have 30-kva transformers. Other standard models are available from 10 to 50 kva.

Circle 580 on Readers' Service Card

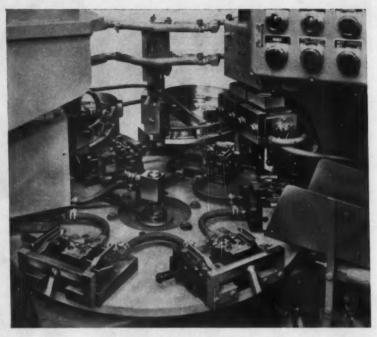


Fig. 2. Geneva dial-feed table of Precision AVB-3 welding machine with loading, assembling, forming, welding, and ejection stations

### Micro-Path Magnetic Tape Control Facilitates Titanium Milling Operations

The machining of titanium and similar materials is a critical operation in the production of aircraft and missile parts. If cutting stops and the cutter burnishes the work, the material almost instantly workhardens. Before machining can be recommenced, the hardened area must be first removed to avoid

damaging the cutter and spoiling the part. By programming an automatic machine cycle on a magnetic tape control introduced by Micro-Path, Inc., Los Angeles, Calif., production on this type of work has been increased 1600 per cent. Cutter stops and dwells have also been eliminated, thus overcoming work-hardening problems.

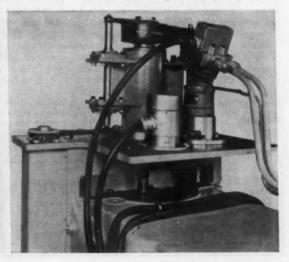
The Micro-Path control is installed on a Cincinnati No. 5 vertical-spindle milling machine as shown in Fig. 1. The milling machine is equipped with a 25-hp spindle-drive motor. Power for each axial motion is supplied by

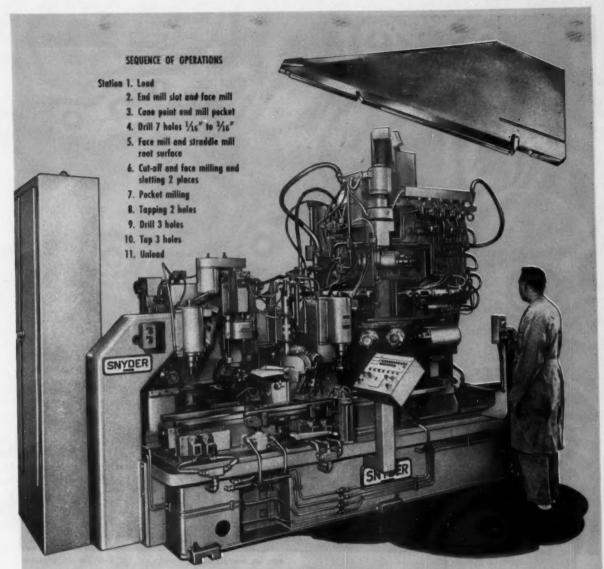
(Continued on page 246)

Fig. 1. Micro-Path tape installation on Cincinnati vertical milling machine



Fig. 2. Vertical lead-screw drive of equipment illustrated in Fig. 1





### COMPLEX MISSILE WING GETS 24 PRECISION OPERATIONS IN SPECIAL SNYDER PROGRAMMING TOOL

at Martin Company's Baltimore Division

Production rate, tolerances and part configuration dictated the fundamental design concept of this exceptionally compact tool which has 11 stations and performs 24 operations.

The cycle can be automatic, semi-automatic or manual. Controls for multiple cycle operations are provided by utilizing basic circuits triggered by a programming control device.

### SNYDER

(Formerly Snyder Tool & Engineering Company)

3400 E. LAFAYETTE—DETROIT 7, MICHIGAN
Phone: LO 7-0123



From left, Pratt and Whitney Aircraft's J-57, J-52, JT-12, and J-75, jet engines.



This typical Fafnir jet engine bearing is fabricated of specially processed alloy steels, the cleanest available. It is an angular contact type bearing with intricate split inner ring. All components are precisely fitted. Balls and raceways are precision-finished to millionths of

### Fafnir main rotor bearings help carry the load in these Pratt & Whitney Aircraft jet engines!

In a jet engine, the only parts that "anchor" the massive main rotor are the bearings on which the rotor shaft rides. Fafnir is a major supplier of the main rotor thrust bearings that handle this critical assignment in Pratt & Whitney Aircraft jet engines.

Few applications put such a premium on unfailing performance . . . and few involve such operational extremes. The bearing has to support thousands of pounds of thrust load from the rotating parts of the engine, in addition to extremely heavy radial loads under maneuver conditions. They must not only carry these loads but also maintain precise positioning of the rotating parts at 10,000 to 15,000 R.P.M. speeds.

To insure the reliability necessary in this service, Fafnir and Pratt & Whitney Aircraft joined engineering talents to design the rotors for each rotor application. The bearings are practically flawless in every detail of materials and workmanship. The capabilities that produce these "bearing masterpieces" are also available to you. You can rely on Fafnir to meet your most exacting jet engine, accessory, or control bearing needs. Write The Fafnir Bearing Company, New Britain, Conn.

FAFNIR BALL BEARINGS



### NEW CATALOGUES

• Yours for the asking . . . use postcard inside back cover



### Resistance-Welding Alloys

Air Reduction Sales Co., New York City. Catalogue on "Tuffaloy" resistance welding tips, tip-holders, and alloys. Also covered are: bar stock, castings, forgings, welding accessories, and alloy standards. New RW taper numbering system.

Circle Item 501 on Inquiry Card



### Milling Cutters and Tools

O. K. Tool Co., Inc., Milford, N. H. Booklet describing a variety of plain, side, hollow, and end mills. Also shown are form cutters, counterbores, core drills and reamers, etc. Single-point tools are also illustrated. Cutting edges protected by plastic dip.

Circle Item 507 on Inquiry Card



### Systematic Purchasing Concept

General Electric Co., Schenectady, N. Y. Booklet (GED-3877), providing a detailed approach to the systematic appraisal of product value in business purchasing. It describes methods used by General Electric to improve its own purchasing methods.

Circle Item 502 on Inquiry Card



### Heavy-Duty Ball Bearings

Split Ballbearing Division of M P B, Inc., Lebanon, N. H. Catalogue 60, describing Type HDR high-precision radial ball bearings, with load capacities from 19 to 55 per cent greater than equivalent size Conrad bearings. Four clearance ranges are available.

Circle Item 508 on Inquiry Card



### **Positioning Posts**

Onteora Mfg. Co., Ashokan, N. Y. Folder on a new setup saver for milling machines, called "Posit-Posts." It improves accuracy and slashes get-ready time. Using sine-bar principle and micrometer, accuracy to seconds is assured.

Circle Item 503 on Inquiry Card



### **Tape-Controlled Machining**

Kearney & Trecker Corporation, Milwaukee, Wis. Bulletin No. AP-60 "Around a Part in Just 8 Days," describing in pictures the actual story of how a typical Milwaukee-Matic job was processed from print to finishmachined part in only eight days.

Circle Item 509 on Inquiry Card



### Special Presses

Federal Machine & Welder Co., Warren, Ohio. Bulletin 52200, on the "Warco" straight-side, piercing-notching and blanking presses with capacities of 100 to 800 tons inclusive. General data and construction features, and specifications are given.

Circle Item 504 on Inquiry Card



### **Hydraulic Cylinders**

S-P Mfg. Corporation, Solon, Ohio. Catalogue 117, describing a line of high-pressure hydraulic cylinders (2000 psi, and 3000 psi nonshock) Series B. Among the features of the cylinders are precision-machined end plate and external quick-change cartridge.

Circle Item 510 on Inquiry Card



### **High-Speed Sheeting Lines**

F. J. Littell Machine Co., Chicago, Ill. Bulletin G-10, pointing up operational advantages of the Littell sheeting line. Its guaranteed ability to hold tolerances of 0.007 inch on length and squareness at speeds of up to 75 3-foot blanks a minute indicates its accuracy.

Circle Item 505 on Inquiry Card



### **Optical Comparator**

Jones & Lamson Machine Co., Springfield, Vt. Booklet presenting J & L comparators for fast, simple, and reliable quality control. Measurements as fine as 0.0001 inch can be made with ease. It makes possible the inspection of deep holes.

Circle Item 511 on Inquiry Card



### Gages

Standard Gage Co., Inc., Poughkeepsie, N. Y. Catalogue No. 35, presenting eleven new products—mechanical dimensional gages, pitch-diameter comparator for fast checking of threads or gears, dial snap-gage models, and limit type form and groove gages.

Circle Item 506 on Inquiry Card



### Gaging Short Cuts

Hi-Precision Grinding, Inc., Costa Mesa, Calif. Booklet presenting new approaches to gaging problems and showing suggested uses of tenth plug gage kits and precision "MicroBall" gage kits. Information given is applicable to most other types of gages.

Circle Item 512 on Inquiry Card

• Yours for the asking . . . use postcard inside back cover



### **Chaser Threading**

National Acme Co., Cleveland, Ohio. Bulletin DV-1, covering the application of the new "5-Chaser Vers-O-Tool." Evaluation of the use of this tool as it relates to producing threads on pieces having flats, keyways, slots, for drilled holes is outlined.

Circle Item 513 on Inquiry Card



### **Work-Handling Equipment**

Reed Rolled Thread Die Co., Holden, Mass. Bulletin 1-11, on work-handling equipment for thread and form rolling machines. Illustrations show specifications of nose cone, vacuumtube base, burster tube, pipe plugs, fuse cover, bearing cap, etc.

Circle Item 519 on Inquiry Card



### All-Stainless-Steel Filters

Micro Metallic Division, Pall Corporation, Glen Cove, N. Y. Bulletin (M-213A) describing all-stainless-steel filters and filter elements. Lists availability of porous stainless-steel Surfamax filters designed for maximum filter surface in minimum volume.

Circle Item 514 on Inquiry Card



### Felt and Felt Products

Felters Co., Boston, Mass. Booklet describing felt as a design material and providing information to help engineers apply felt and felt products. Information is included on design properties, descriptions of special treatments, and data on how to select.

Circle Item 520 on Inquiry Card



### Drill Heads

Thriftmaster Products Corporation, Lancaster, Pa. Catalogue featuring multiple-spindle drill heads with special alloy-steel driver, spindles and gears hardened and carefully heat-treated. Specifications are given for all Thriftmaster drill heads.

Circle Item 515 on Inquiry Card



### Recessing Tools

Madison Industries, Inc., Providence, R. I. Brochure on a new automatic recessing tool. This tool cuts recesses to exact depth, width, and position in one operation. It will complete a recessing job in three to seven seconds. Specifications are given.

Circle Item 521 on Inquiry Card



### Bearings

Hoover Ball & Bearing Co., Ann Arbor, Mich. Bulletin No. 114, describing cylindrical roller bearings with "super finish" rollers and raceways. Other features: machined bronze retainers, and five variations, all separable to simplify installation.

Circle Item 516 on Inquiry Card



### Dial-Feed Welders

Taylor-Winfield Corporation, Warren, Ohio. Brochure 8-213, describing a dial-feed mechanism for dial-feed resistance welders. Included are drawings and photographs of the Geneva index mechanism, as well as a graph and photographs.

Circle Item 522 on Inquiry Card



### Multiple Tapping and Drilling Heads

Ettco Tool & Machine Co., Inc., Brooklyn, N. Y. Bulletin 600C, on "Knuckle-head" universal ball-joint adjustable spindle tapping and drilling heads. Five models which convert drill press into a high-production machine are available.

Circle Item 517 on Inquiry Card



### **Cut Machining**

Wallace Supplies Mfg. Co., Chicago, Ill. Catalogue on the value of cut machining, in which both cut ends of metal rods, angles, channels, I-beams, and solid bar stock are cut clean with circular abrasive saws. Secondary operations can be eliminated.

Circle Item 523 on Inquiry Card



### Motor Drive

General Electric Co., Schenectady, N. Y. Booklet (GEA-7012), describing G-E's new Parmatic Speed Variator, a compact, packaged, adjustable-speed, direct-current motor drive that operates from alternating-current power. It features static power conversion.

Circle Item 518 on Inquiry Card



### "Manufacturing Program 1960"

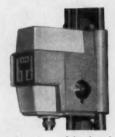
Misal Precision Machine Tool Co., Redwood City, Calif. Catalogue presenting a line of lathes, milling machines, shapers, slotting machines, grinders, saws, and drilling machines. Varieties of all tools are described and illustrated.

Circle Item 524 on Inquiry Card

### Here's Why Accurate Honing Is Easier On The New BarnesdriL Model 244...



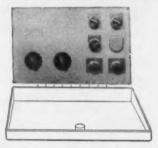
Hone Feed - simple dial gives infinite adjustment.



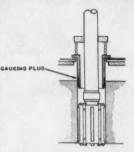
4-Speeds - turn of knob selects desired speed rate.



Reciprocation - length of stroke selected by convenient dial.



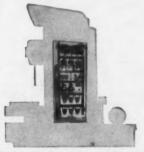
Set-Up - controls under lock and key.



Plugmatic — automatic sizing assures accuracy within .0002".



Operating Controls - mounted at shoulder height.



All Electric Controls - enclosed inside machine column.



Coolant Pump and Hydraulic Valves easily accessible.



Hydraulic Pump - in open, for easy maintenance.

BarnesdriL offers a completely new honing machine for high production honing of bores 1/2" to 6" in diameter. Large diameter applications depend upon amount of stock removal, bore length, and-material. Machine is available with one or two spindles and a choice of three stroke lengths: 15", 25", or 40". For complete details see your BarnesdriL representative or write for new bulletin H-112 today!



DETROIT OFFICE: 13121 Puritar



· Yours for the asking . . . use postcard inside back cover



### **Numerical Positioning Control**

General Electric Co., Waynesboro, Va. Booklet GEA-7010, describing standard- and custom-design systems for automatic control. G-E numerical-positioning control overcomes the inherent time-consuming limitations and inaccuracies of manual positioning.

Circle Item 525 on Inquiry Card



### Tracer Mill

Famco Machine Co., Kenosha, Wis. Catalogue on the great variety of work that can be done with the company's tracer mills. They range from completely automatic to manual tracers in one, two, and three dimensional models. Precision duplicating.

Circle Item 531 on Inquiry Card



### Molybdenum-Base Alloys

Climax Molybdenum Co., New York City. Booklet on "Climelt" molybdenum products for all executives, purchasing agents and others interested in the unique combination of properties found in these materials. It gives full details.

Circle Item 526 on Inquiry Card



### **Automatic Arc-Welding Machines**

Taylor Winfield Corporation, Warren, Ohio. Bulletin 8-513A, describing fourteen special, high-production, automatic, arc-welding machines with emphasis on production rates obtainable. The bulletin shows special features for automatic operation.

Circle Item 532 on Inquiry Card



### **Motorized Hardness Tester**

Torsion Balance Co., Clifton, N. J. Bulletin CRS-60, describing the Kentrall line of four motorized hardness testers. By removing major test loads automatically, these hardness testers increase the reproducibility of test results.

Circle Item 527 on Inquiry Card



### Stainless Steel with Boron

Carpenter Steel Co., Reading, Pa. Technical data sheet describing the company's stainless Type 304 with boron. Type analysis and descriptions are given, as well as details of physical constants, workability, and forms available (hot-rolled bars, etc.).

Circle Item 533 on Inquiry Card



### Universal Machine

Wisconsin Drill Head Co., Butler, Wis. Bulletin 506, describing a versatile, machine which performs a variety of drilling, tapping, boring, reaming, and spot-facing operations on as many as five sides of a part in one work

Circle Item 528 on Inquiry Card



### Lathes

South Bend Lathe, Inc., South Bend, Ind. Catalogue on a line of lathes, accessories, and other machine tools. Lathes of many dimensions are illustrated. Specifications are given. Also shown are grinding attachments for precision toolroom grinding.

Circle Item 534 on Inquiry Card



### Worm-Gear Speed Reducers

Link-Belt Co., Chicago, Ill. Book 2824, 66-page publication introducing the company's new line of fan-cooled worm-gear speed reducers in twenty-five types and over 135 sizes. They are available in ratios ranging from 5:1, to 3600:1.

Circle Item 529 on Inquiry Card



### Noise Reduction

A. M. Byers Co., Pittsburgh, Pa. Brochure describing a case study that shows how users and manufacturers of machine tool equipment can reduce machine-shop noise 83 to 88 per cent and completely eliminate bar stock damage.

Circle Item 535 on Inquiry Card



### Synchronous Motors

Avionic Division, John Oster Mfg. Co., Racine, Wis. Synchro catalogue No. 4000, contains definitions, drawings, circuit diagrams, and characteristics of basic line of size 8, 10, 11 and 15 synchros for military, industrial, and scientific applications.

Circle Item 530 on Inquiry Card



### **Power Saws**

DoALL Co., Des Plaines, Ill. Catalogue describing and illustrating a new line of DoALL power saws, consisting of Models C-67 and C-68 for straight cutoff work and Models C-167A and C-168A for mitering and angular, as well as straight, cutoff work.

Circle Item 536 on Inquiry Card



RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY



Technical-ities

By Fred E. Graves

### Fastening of gasketed joints

The right fastener for a "flexible" joint rests on type of gasket material and its compressibility. Total preload on all the fasteners in the connection must be enough only to compress the gasket and provide sufficient additional clamping force to withstand the hydrostatic test pressure. More than this brings on a good chance of leakage, through "bowing" of the clamping plate.



Exaggerated sketch showing how too much torque tends to distort clamping plate and leads to leakage.

### HYPOTHETICAL CASE

Suppose a joint is tightened with Grade 5 Hex Screws to their yield strength, and leakage develops. By going to alloy screws and tightening still further you would still get leakage. But Grade 2 Hex Screws, all torqued evenly, would no doubt solve it.

### ACTUAL CASE

The fasteners on one product's flange had to withstand a 4000 pound hydrostatic pressure. But the hard asbestos gasket used took a bolt load of 28,000 pounds for sufficient compression to seal. By substituting a rubber and fibre gasket in this case, bolt load could be reduced. So could bolt size, thereby saving 73% on fasteners.

### Using Hex Screws in tapped holes saves money



In the cast "coupon" shown above, the hex screws were torqued tight and removed 50 times—then torqued to failure. Note in the cutaway that the casting's threads are still perfect with no sign of stripping. It was the screws which broke—a clear demonstration that castings fastened with hex screws will suffer no thread damage during repeated disassemblies.

### TWOFOLD BENEFIT

When there are no space clearance problems or other special requirements, using studs of 1-inch diameter or smaller often penalizes the user. First, in direct costs, since the more economical hex head screws will do the job to specification. And second, in production costs, since studs require that tapped holes have an interference thread fit, which in turn results in slow, "selective" assembly to determine properly

mated threads. Hex screws need only a clearance fit, assemble faster.

### ACTUAL EXAMPLE

In one of his surveys of fastenings used by one company, the RB&W engineer pointed out that over 250 stud fastenings were being used in a large refrigeration unit. The same number of hex screws, costing \$8.45, saved \$22 over the studs and nuts. Annually, the total would be \$7,800 on the production run of this unit.

Not to be overlooked either was the tangible saving on the less critical tapping job required.

RB&W offers its help on your specific fastener problems, or an overall survey of your fastener usage. Contact Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.

Plants at: Port Chester, N.Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

### catalogues . . . . bulletins . . . . manuals

· Yours for the asking . . . use postcard inside back cover



### Filtration Products

Purolator Products, Inc., Rahway, N. J. Booklet (IND-1-60) listing and detailing information on various filter media for process fluids, nuclear applications, internal combustion engines, hydraulic fluids, machine tool coolants, etc.

Circle Item 537 on Inquiry Card



### Special Control Systems

Electronics Division, Seneca Falls, N. Y. Bulletin EE-1008, describing electromechanical control systems and components for use on a wide variety of production machinery. It contains information on point-to-point control systems, speed control systems, speed

Circle Item 543 on Inquiry Card



### **Optical Tooling**

Farrand Optical Co., Inc., New York City. Bulletin 808 presenting a line of optical tooling for aircraft, power generators, and precision machines. These include: alignment telescope, optical square, kinematic telescope mount, cross wire target, etc.

Circle Item 538 on Inquiry Card



### **Thread-Rolling Heads**

Landis Machine Co., Waynesboro, Pa. Bulletin F-99-3, covering the No. 3 1/2 thread-rolling head having an NC and NF range from 7/16 to 1/4 inch. Information pertaining to the design and operating features is given. Illustrations and specifications are supplied.

Circle Item 544 on Inquiry Card



### Gearing System

Spiroid Division, Illinois Tool Works, Chicago, Ill. Pamphlet introducing a new gearing system called "Helicon" gears. It may be of benefit to engineers looking for a gear system offering low cost, yet a high degree of insensitivity to mounting errors.

Circle Item 539 on Inquiry Card



### Special Services

U. S. Electrical Motors Inc., Los Angeles, Calif. Bulletin No. F-1974, outlining "The 8 plus Values That Back up U. S. Motors." It describes the six major plants and facilities coast-to-coast, a day-and-night operation always for the customers' service.

Circle Item 545 on Inquiry Card



### Small Tools

Durant Tool Supply Co., Providence, R. I. Folder describing a line of small-tool equipment including friction type roll feeds; stock straighteners; scrap choppers; wire straighteners; stock reels; foot presses; sweep guards; punch holders; toolmakers clamps, etc.

Circle Item 540 on Inquiry Card



### **Drilling Machines**

Lahr Machine & Tool Corporation, Toledo, Ohio. Folder on new-model drilling machines. A feature of each machine is tape control for numerically controlled production. Machines are described in general with over-all dimensional data.

Circle Item 546 on Inquiry Card



### Milling Machine

Kent-Owens Machine Co., Toledo, Ohio. Brochure showing features of the No. 3-36 machine in conventional and climb milling. This equipment has automatic hydraulic table feed, a table working surface of 64 by 16 inches, and a fully automatic cycle.

Circle Item 541 on Inquiry Card



### Instrument Gear Data

Engineering Data Supply, Los Angeles, Calif. Booklet presenting tables of precalculated gear data and dimensions, intended for the use of designers of mechanical devices using instrument gears. The diametral pitches were selected on basis of most frequent use.

Circle Item 547 on Inquiry Card



### Air-Powered Drill

Ingersoll-Rand Co., New York City. Folder describing "Mech-feed," an airpowered drill that gives matched positive feed rate, accurate drilling, clean holes, and lessens operator fatigue—ideal for drilling alloys variable setups, gang drilling, etc.

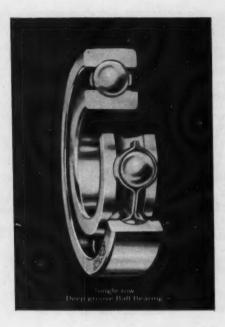
Circle Item 542 on Inquiry Card



### **Plating Solutions**

Hanson-Van Winkle-Munning Co., Matawan, N. J. Booklet describing simple analytical methods for plating solutions. Procedures outlined may be easily carried out by nontechinical personnel. Preface is a discussion of analytical principles, etc.

Circle Item 548 on Inquiry Card



## Can a standard bearing offer you "more bearing" for your money?

It can if it's made by BEF-because all BEF bearings, both ball and roller, offer special qualities at "production" bearing prices.

Take the single-row deep-groove ball bearing featured here, as an example. BEF designs and builds this type to sustain heavy radial load and thrust load in either direction. Furthermore, it is engineered to run smoothly and quietly at normal speeds with grease lubrication—and at high speeds with oil.

Yet this is a standard BESF ball bearing, mass-produced by automated production equipment at our plant at Altoona, Pa. You can quickly get this bearing in over 100 sizes, ranging from 5/6" to 15.748" O.D., and in a variety of seal, shield and snap-ring combinations.

But why not find out what BEF offers in bearing quality, availability and economy? Just call the BEF branch office nearest you.













Cylindrical Roller Bearing · Yours for the asking . . . use postcard inside back cover



### **Annular Form Grinder**

Sheffield Corporation, Dayton, Ohio. Catalogue No. FG-181-260, presenting a machine for grinding annular forms and grooves in work-pieces up to 10 inches in diameter and 24 inches between centers, called the Model 181 Multiform grinder.

Circle Item 549 on Inquiry Card



### **Numerical Positioning Control**

Hughes Aircraft Co., Los Angeles, Calif. Booklet on the company's two-axis numerical-positioning control system and possible third control axis. Control cabinet is compact, requiring minimum floor space. Modular construction is employed.

Circle Item 555 on Inquiry Card



### Gear Shaving

National Broach & Machine Co., Detroit, Mich. Reference manual entitled "Essentials of Rotary Gear Shaving" (5-60-1B), prepared especially for gear designers, gear manufacturing engineers, gear production supervisors, and gear production machine operators.

Circle Item 550 on Inquiry Card



### Hydraulic Drill Units

Leland-Gifford Co., Worcester, Mass. Folder giving features of self-contained hydraulic drill units. Among these are: totally enclosed ball bearing NEMA standard motor; rigid cast-iron motor support and belt guard; built-in limit switch; etc.

Circle Item 556 on Inquiry Card



### Surface Grinders

Covel Mfg. Co., Benton Harbor, Mich. Bulletin No. 560-1, describing the "Compact" line of precision surface grinders from 6- by 12- inch to 10- by 16-inch capacity in both hand- and power-feed models. Included is the new No. 6A cutter and tool grinder.

Circle Item 551 on Inquiry Card



### Punched Hole Facts

Dayton Perforators, Inc., Dayton, Ohio. Folder giving specifications and data for the new "Pups" punch line and offering application data. "Pups" (Proven Usage Punch Sizes) are said to meet 87 per cent of user's needs for heavy-duty, head type punches.

Circle Item 557 on Inquiry Card



### Bit Grinder

Drillers Service, Inc., Hickory, N. C. Bulletin No. 101, on a bit-grinding machine for all users of carbide insert bits. It increases drilling rates and prolongs bit life and grinding wheel life. Detailed illustrations show versatility of the equipment.

Circle Item 552 on Inquiry Card



### Die-Saver Switch

Robotron Corporation, Detroit, Mich. Folder for volume producers of formed parts—ferrous or nonferrous—who wish to effect big cost savings in their die press operations. It explains how you can do it with a new diesaver switch control system.

Circle Item 558 on Inquiry Card



### Milling Machines

Cincinnati Milling Machine Co., Cincinnati, Ohio. Catalogue 2110, on Toolmaster milling machines which are available in four different styles: 1B, 1C, 1D, and 1E. The differences between these units is in the spindle carrier design.

Circle Item 553 on Inquiry Card



### Steel Bars

La Salle Steel Co., Chicago, Ill. Bulletin No. 10, on a line of "Fatigue-Proof" steel bars which combine high strength, free machining, uniformity, fatigue resistance, wear resistance, and dimensional stability. They have accuracy and smooth finish.

Circle Item 559 on Inquiry Card



### **Nonferrous Specifications**

Centrifugally Cast Products Division, Shenango Furnace Co., Dover, Ohio. Chart (Bulletin No. 157) showing comparative specifications, chemical analyses, and minimum physical properties of nonferrous alloys. It also describes parts produced by centrifugal method.

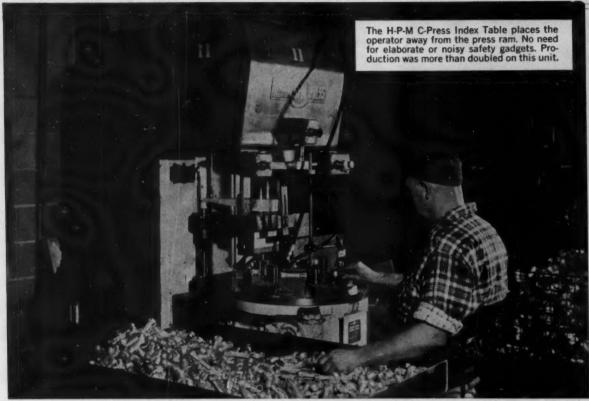
Circle Item 554 on Inquiry Card



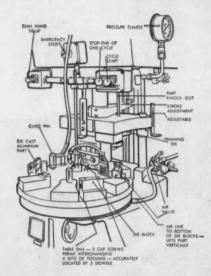
### **Heat-Treating**

Drever Co., Bethayres, Pa. Bulletin No. B-81, covering the use of furnaces and equipment for heat-treating stainless steel as strip, sheet, tube, wire, bar, and formed and machined products. It describes the equipment used in each operation.

Circle Item 560 on Inquiry Card



### H-P-M C-Press with Hydraulic Index Table BASIC AUTOMATION AT ITS BEST



Standard 15-ton C-Press with 6-station index table. 5, 10, 15-ton models with 6, 8 or 12 station tables available. A solid money-making investment for faster, safer metal working.

The job illustrated is tooled for the trimming of die cast parts. Its high-production capacity can be applied to any number of routine production tasks. Look at these versatile features: (1) The index table allows the operator to load parts away from the press ram—in safety and comfort, no wasted waiting time while ram cycles; (2) As many as three operators may be located around this small table for assembly or other operations; (3) Automatic ejection, using air from shop lines makes an effective and time saving contribution to faster production; (4) The die blocks or holding fixtures are located at six stations on this unit. Table dials are dowelled in position for accuracy—may be removed so that different tooling set-ups are replaced in a matter of minutes. Production can be tripled with this type of C-Press.

SAFETY ASSURED WITH C-PRESS METHODS

The operator sits in front of the dial away from moving ram. Fixtures are loaded as they pass his station and are automatically indexed to the next station. Hands never enter the danger zone.

An investment of this type is amortized in minimum time. Want to know more? Write or call H-P-M today. The coupon will assure complete information, immediately.

Index Table, I'd lil	ete information on the H-P-M C-Press with the to triple my production, too.
Name	Title
Address	
Company	
City	Zone State

MMT-PE

### THE HYDRAULIC PRESS MANUFACTURING COMPANY

A Division of Koehring Company . Mount Gilead, Ohio, U.S.A.



### BETWEEN GRINDS

### Office Mata Hari

Recording paper is now on the market (Industrial Research Newsletter informs us) with automatic message erasure and reappearance, thus eliminating the need for many security precautions. The paper, developed by the Alfax Paper & Engineering Co., allows messages to be received directly on a recorder, then processed into envelopes before the message reappears, so that only the original sender and recipient see the contents. We are curious to know when does the message decide to reappear.

### **Quicker Flickers**

A movie camera that magnifies time by 100,000 is now in production. It was developed originally by Dr. Albert T. Ellis for the express purpose of photographing gas bubbles appearing in turbulent fluids (an apt description of some recent moving pictures, also). It's done with mirrors, incidentally, since the film remains stationary while a mirror revolves at the rate of 100,000 rpm. The camera is being used success-

fully in high-speed impact studies, like firing a bullet at 4000 feet per second into a block of ordinary gelatin.

### **Coffee Timer**

"Versatimer" is the name of a new product intended to prevent abuse of coffee-time breaks. The office manager or foreman simply sets the timer to the length of break desired (like ten minutes, or twenty, or thirty) and presses a button sounding a buzzer to signify start of the break. At the end of the allotted time, the buzzer automatically sounds once again—but whoever comes the first time called?

### **Shake Our Handle**

"Permeter" is the name of a new instrument, introduced by Ameresco, Inc., which measures hand perspiration. It is particularly useful in hiring personnel for assignments involving delicate handling operations in which materials may easily be corroded by perspiration. Just grasp the handle of the gadget. Nervous, eh!

### Our Hats Off to Coat Hangers

According to Steelways, highspeed iron and steel machines convert miles of steel wire into more than 500,000,000 coat hangers annually, mostly for dry-cleaning establishments—enough wire to stretch to the moon and halfway back (don't sign up for this trip unless you can get return passage on another line). Besides keeping closets tidy, the hangers have other uses, such as spears for roasting hot dogs and marshmallows, tie and hat racks on closet doors, plungers for clogged drains, and trellis supports for vines.

### Blow as You Go

Inflatable, seamless metal tubing, called "Strubing," has been developed by Wolverine Tube, division of Calumet & Hecla, Inc. It is rolled flat into ribbon form on a Fenn 8-inch precision rolling mill. Thus, it becomes possible to ship thin-walled tubing economically, since only the tube "walls" are shipped and not the "hole," and to inflate the tubing as needed.

SPARKLE IN THEIR EYES-But we can't see it because these men have their eyes glued to diamonds—synthetic diamonds successfully made by the Norton Co., the result of a longtime company project. Seen in the picture are, from left to right, Loring Coes, Jr., assistant director of research and development; Dr. Paul P. Keat, senior research engineer; and Wallace L. Howe, vice-president and director of research and development. No commercial production is anticipated presently although applications for patents on both processes and apparatus have been filed. It so happens that Norton is observing its seventy-fifth anniversary, or Diamond Jubilee, in 1960. What better way than to make your own!





### 1000 strokes a minute!

Now in daily operation at the Truarc Retaining Rings Division of Waldes-Kohinoor, Inc., of Long Island City, New York, this new Bliss High Production Press is running at the blurring speed of 1000 strokes a minute, hour after hour, day after day. First of its kind, this completely new press has a revolutionary counterbalancing system and massive, close tolerance construction that virtually eliminate vibration, even at this phenomenal speed. Could a press like this cut your parts cost...add to your profit picture? We'll be glad to give you the facts.



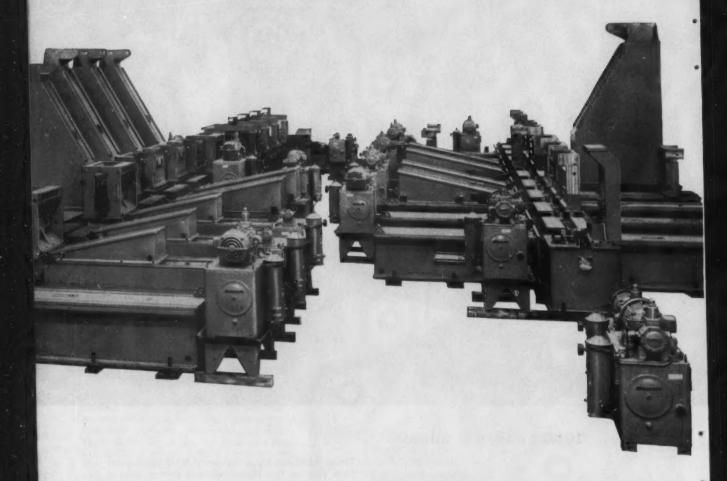
### E. W. BLISS COMPANY . Canton, Ohio

BLISS is more than a name—it's a guarantee

PRESSES . ROLLING MILLS . ROLLS . DIE SETS . CAN MACHINERY . CONTRACT MFG.

Report to the SMTS\* Committee

**GESTATION PERIOD:** 





BUHR MACHINE TOOL COMPANY . ANN ARBOR, MICHIGAN

# with BUHR'S BABY

Standard building block by standard building block, Buhr's Baby is fast taking shape. Wing bases, center bases and other standardized components are being assembled and made ready to receive special tooling and auxiliary features which are being completed.

Buhr's Baby, as you may know, is to be an Economatic lift-and-carry transfer—the first major piece of equipment to be built to the Special Machine Tool Standards. This "Baby" will perform 323 precision operations in automatic sequence and will be the most flexible and readily convertible multiple operation machine tool ever built.

BUHR

(say BURE)

ECONOMATIC



Fig. 3 Titanium engine mount processed on machine seen in Fig. 1

2-hp hydraulic motors. Commands from the magnetic tape actuate electrical Pulservos which control hydraulic servo valves. These meter the fluid flow to the axial-drive motors in exact proportion to motion commands. The Pulservo link to the servo valves constitutes a closed-loop system which insures exact motion response to the taped commands at all times.

The vertical lead-screw drive with cover removed is shown in Fig. 2. Amplified electrical commands from the magnetic tape program are converted to motion by the Pulservo (front center) which actuates servo valve (upper right). Hydraulic fluid is metered to the hydraulic drive-motor (beneath valve) which is timing-belt-geared to the vertical lead-screw. The small timing belt to the extreme left drives a shaft with a counter and dial at its lower end.

The titanium engine mount, Fig. 3, processed on the machine equipped as shown in Fig. 1, is 5/16 inch thick and has a contoured periphery measuring 100 inches. Manual production of this typical titanium part required four hours. With the Micro-Path installation, three parts were stacked together and machined in forty-five minutes, giving a production time of fifteen minutes for each part as against four hours for manual production. The tape-controlled machine is completely automatic in operation-requiring only loading and unloading of the work-pieces. The part is held to template size within 0.003 inch.

Once programmed, the magnetic tape reproduces the part at any later date.

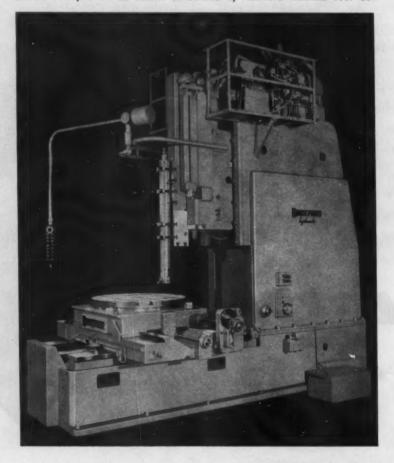
Circle 581 on Readers' Service Card

### "Hy-Draulic" Slotter with Push-Button Control

One of the most important features of the SM 36-inch stroke "Hv-Draulic" slotter, manufactured by Rockford Machine Tool Co., Rockford, Ill., is its operation by push-button control. A counteroperating balanced pendent, through a range of 240 degrees, permits the operator to run the machine from any position. The simplicity of the Hy-Draulic drive and feed are said to make this machine extremely easy to set up and operate. No levers are required for the engagement of any feed or traverse movement. The pendent provides selection for longitudinal, rotary, and transverse movements. Two-speed traverse is available, enabling the operator to reposition the stroke and lengthen or shorten it directly from the pendent, without levers or cranks, or without stopping the machine. The ram is locked from the pendent. Interlocked "start" and "stop" buttons prevent it from running when in the locked position.

This rigid and powerful machine has a broad field of production application on all kinds of slotter work. Its scope has been greatly increased by making provision for tilting the ram from the vertical position to 10 degrees forward for travel in any angular plane. The drive of the Model SM is fully hydraulic, with two speeds and servo control to the pump so that the cutting and return speed may be infinitely varied from zero to maximum in either range from the operator's position. The hydraulic feeds can also be varied infinitely from zero to maximum from the operating position. A 40-hp, variable-delivery, radial-piston pump located on top of the column is

Slotter with push-button control announced by Rockford Machine Tool Co.



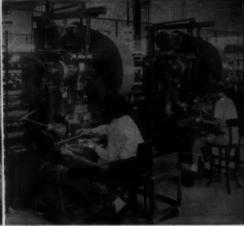


### 39 OBI'S GIVE PRESS DOLLARS 3-WAY STRETCH

Newly installed Niagara Inclinables provide required precision at lower investment, produce more parts per hour, and cut maintenance to the bone





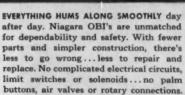


SERVING ONE OF THE WORLD'S LARGEST typewriter manufacturers in a brand-new plant, 39 new Niagara Series A Open Back Inclinables play a key role in the production of nearly 2000 precision parts for portable machines. With selection based on past experience, these presses are more than living up to expectations... performance-wise and dollar-wise.

.001" TOLERANCES ARE MAINTAINED as Niagara OBI's engage in a wide variety of piercing, notching, trimming, bending and intricate forming operations. Here, a hinge tab is given a final bend on a 22-ton Niagara Series A. Rigid press frames and short-coupled, multiple "V" gibs not only insure precise production, but lengthen die life.

BOOSTING PRODUCTION 30%, these fastacting hand fed OBI's turn out an average of 1300 pieces an hour per machine. The reason: Instant clutch engagement and disengagement at every press stroke provide more working strokes per minute. Niagara's famed multi-point mechanical sleeve clutch picks up the load on 14 engaging jaws and applies driving force concentrically without keys or pins.







MAINTENANCE IS SHAVED TO AN "ABSO-LUTE MINIMUM" according to this Niagara user. Unlike other presses previously utilized, these Series A's do not require constant "doctoring." There's no need for frequent adjustment of the clutch sleeve and brake. No "dogs" to break off and require replacement. No press can match its economy.



WANT TO STRETCH YOUR PRESS DOLLARS, TOO? Write for illustrated Bulletin 58 containing the facts and figures on Niagara Series A Open Back Inclinable Presses (built in 13 standard sizes with shaft diameters from 1½" to 6½" and capacities from 5½ to 190 tons). Niagara Machine & Tool Works, Buffalo 11, N. Y., District Offices and Distributors Everywhere.

NIAGARA

OBI PRESSES

America's most complete line of presses, press brakes, shears, other machines and tools for plate and sheet metal work.

employed for hydraulic power.

The slotter is equipped with built-in dividing head for power indexing of keyway, serration, gear-tooth, and other machining cuts.

Circle 582 an Readers' Service Card

### Greenerd Hydraulic Expanding Press

An E-62 self-contained hydraulic expanding machine has just been announced by the Greenerd Arbor Press Co., Nashua, N. H. This is the latest addition to a line of such equipment ranging in size from 15 tons to a maximum of 400 tons developed in cooperation with manufacturers of jet engines. In this line of presses are water-cooled models designed for sizing titanium parts. The machines and tooling are made to close tolerances to assure the production of accurately formed or sized parts.

The E-62 machine has a maximum ram pull of 62 tons. A similar Model E-93 machine with a maximum ram pull of 93 tons is also available. Component parts of the main machine are cast of hard Meehanite metal. The cylinder is bored and honed to size and is equipped with steel piston and

cast-iron piston rings. The hydraulic power unit is mounted on the oil sump behind the machine, and is connected to the cylinder with flexible high-pressure tubing. These machines are adapted for sizing or stretching sheet-metal cylinders, cones, or bands to the close limits of size required.

The pie-shaped segments that mate with the master segments furnished with the machine are inexpensive and permit the use of the equipment to its fullest advantage on experimental and shortrun jobs, as well as for production work.

Circle 583 on Readers' Service Card

### **Brown & Sharpe Slicing and Dicing Machine**

A slicing and dicing machine that automatically cuts semiconductor materials such as germanium, silicon, quartz crystals, etc., into wafers has been announced by the Brown & Sharpe Mfg. Co., Providence, R. I. The wafer sides are held parallel within 0.0001 inch and the thickness is consistently maintained to plus or minus 0.0002 inch. This equipment, utilizing a metal-bonded or resinoidbonded diamond wheel, produces "burn-free" wafers. The table-driving mechanism provides a smooth feed that is adjustable from 0.100 inch to 144 ipm. Rapid table positioning is adjustable to approximately 25 fpm.

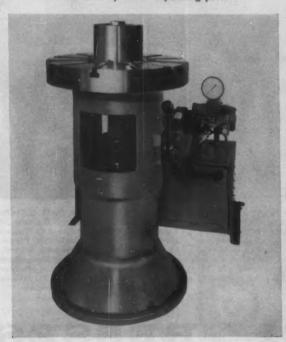
The table is mounted directly on the fixed bed in vee and flat ways to eliminate twist. A rugged cast-iron upright moves transversely in vee and flat ways on the bed casting. Cross-feed is actuated automatically at the beginning of each cycle by a hydraulic-mechanical arrangement, accurate to plus or minus 0.0002 in and adjustable from 0 to 0.1000 inch. Total amount of index is read directly from the handwheel which is graduated in increments of 0.00025 inch and is adjustable independently of the handwheel to facilitate setup.

With the addition of a wheel sleeve and by arranging the wheels in gangs, wafers can be diced in quantities with one pass of the table. For dicing only, machines are available without automatic cross-feed and indexing mechanisms.

Circle 584 an Readers' Service Card (This section continued on page 254)

Greenerd hydraulic expanding press

B & S slicing and dicing machine







Attention
missile
tooling
engineers

## CUSHMAN



## GENERAL ELECTRIC PRE-HONED



Hand-honing is inaccurate, time-consuming—often results in premature chipping and breaking.

Now you get more predictable tool life... lower cost per cutting edge ... no hand-honing cost!



Chamfered, or ground-flat, edges are geometrically weaker than a radius and are more easily chipped or broken.



Unhoned or as-ground inserts show rough edges—result in unpredictable tool life due to chipping.



#### TOPS IN TOOLING QUALITY

From the research and quality-control facilities of the Metallurgical Products Department of General Electric comes the outstanding quality tooling line in the metalworking industry. The new Carboloy pre-honed inserts, as well as the complete line of Carboloy toolholders, inserts, insert seats, convertible seats, and brazed tooling, are designed to meet every tooling need efficiently and economically.

## CARBOLOY INSERTS

## Delivered ready-to-use . . . honed to a precise radius . . . promise BETTER PROFITS THROUGH BETTER TOOLING

Now General Electric Carboloy inserts are prehoned at the factory! Here's what it means to you:

1. An insert with edges honed to precise radii gives the strongest geometric shape to withstand cutting pressures. This reduces the chance of chipping—increases the predictability of tool life. Hand honing cannot achieve precise radii—G-E pre-honing can... and does!

2. Since chipping is minimized, fewer cutting edges are wasted. The result is lower cost per cutting edge.

3. Since inserts come pre-honed and ready-touse, the labor cost and inaccuracies of hand honing are eliminated. This more than offsets the additional charge for pre-honing. 4. Pre-honed Carboloy cemented carbide inserts have standard edge radii honed to a greater or lesser degree, depending on the job to be done. You'll know the honing is right!

Ask your Authorized Carboloy Distributor about pre-honed Carboloy inserts, convertible seats, toolholders, and brazed tools. Or, write directly to: Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Ave., Detroit 32, Michigan





Shown here, both under magnification and graphically, is an edge of the new Carboloy pre-honed insert. Radius is geometrically ideal to minimize chipping, extend tool life many times.

CARBOLOY.

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL



ELECTRIC

251

CARBOLOYO CEMENTED CARBIDES . MAN-MADE DIAMONDS . MAGNETIC MATERIALS . THERMISTORS . THYRITED . VACUUM-MELTED ALLOYS

# in Synthe-Seal BEARINGS

Dirt Sealed Out



MRC Synthe-Seal® bearings have a long record of satisfactory performance in thousands of applications including extreme conditions of dirt and moisture.

#### MRC Synthe-Seal® BALL BEARINGS HAVE THESE IMPORTANT ADVANTAGES:

- Flexible synthetic rubber seal is bonded to steel core for strength
- Synthe-Seal® resists operating pressures
- Seal drag is controlled to give low torque with less power required
- Produce economy by eliminating maintenance time
- · Reliability provided by elimination of down time
- Operating range from 80° F. to + 225° F.
- Manufactured to standard AFBMA dimensions and tolerances

Send for FORM 1528 listing sizes available  MRC Synthe-Seal® bearings are backed by 62 years experience in manufacturing ball bearings

bearings

Marlin-Rockwell Corporation

Jamestown, N. Y.



## This Ex-Cell-O Bushing should outlast 2 of the kind you are now using . . .

58-5

## POSITIVE PROOF! EX-CELL-O BUSHINGS GIVE TWICE THE AVERAGE BUSHING LIFE

Recent plant-wide bushing life tests, conducted by a large heavy implement manufacturer, established this astonishing proof of Ex-Cell-O superiority: they lasted more than twice as long as the next best bushings on the market.

After drilling 16,300 test holes, the competitive bushing showed an average .0039" of wear—ready for scrap—while Ex-Cell-O bushings averaged only .0017" of wear, less than half as much!

As a cost-conscious competitive manufacturer, you owe it to yourself to investigate the very substantial savings Ex-Cell-O bushings offer. Test them against any, or all, competitive bushings right in your own plant.

Send your order to Ex-Cell-O Corporation at Detroit, New York, Downey, Cal., Lima, Ohio, and London, Canada. You'll get immediate shipment. Write for an Ex-Cell-O Drill Jig Bushing Catalog today.



MANUFACTURERS OF PRECISION MACHINE TOOLS - GRINDING AND BORING SPINDLES CUTTING TOOLS - TORQUE ACTUATORS - RAILROAD PINS AND BUSHINGS - DRILL JIG BUSHINGS - AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS - DAIRY EQUIPMENT

#### Rotary Index Machine Built to Speed Up Exhaust Manifold Production

A special rotary index machine was recently built by the Ex-Cell-O Corporation, Detroit, Mich., for rapid processing of exhaust manifolds for truck engines. The part is received as a rough casting and machined completely in one automatic cycle, the operations including rough- and finish-milling the joint face pads, drilling all mounting holes, core drilling, and chamfering.

The cycle commences as the operator loads a work-piece. Camoperated jacks are provided to support the part under the flanges of the joint face pads. Rough-milling is the first operation, which is performed by a milling head having one vertical and two horizontal spindles. A longitudinal slide rapid feeds in to a depth whereupon a cross-slide feeds for the length of the component.

Three vertical and six horizontal bolt holes are drilled at the next station, followed by core drilling at the fourth station. A special core drill, designed and manufactured by Continental Tool Works, bores to a predetermined depth and also chamfers the bottom of the hole.

The three joint face pads are finish-milled at the fifth station. As the index-table moves to the load position, a cam releases the support pads ready for unloading. For a twenty-seven-second machine cycle, the gross production is 133 manifolds per hour.

Circle 585 on Readers' Service Card

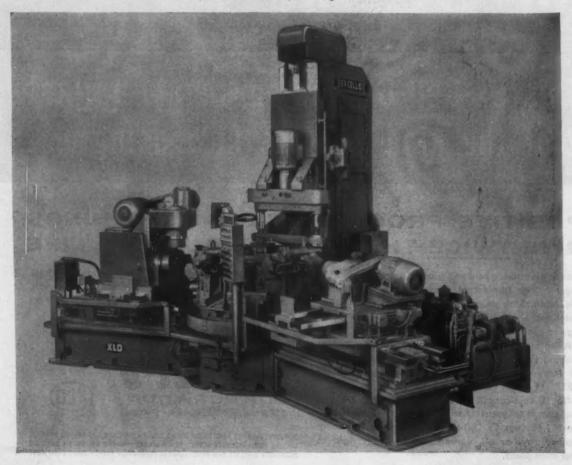
#### Contaminants Removed by Magnetic Separator

The Lincoln Electric Co., Cleveland, Ohio, has announced the development of a magnetic separator for use with automatic and semi-automatic submergedarc welders. This unit is said to improve welder performance and weld quality by removing mill scale, pieces of steel, grindings, spatter, and foreign material accidently picked up during handling. These contaminating materials are caught by three alnico magnets contained in a cylindrical funnel.

The magnetic separator is designed for use with mild-steel and low-alloy-steel fluxes. It is not recommended for use with the higher-alloy fluxes because it would remove some of the alloy.

Circle 586 on Readers' Service Card (This section continued on page 258)

Ex-Cell-O special machine for processing exhaust manifolds



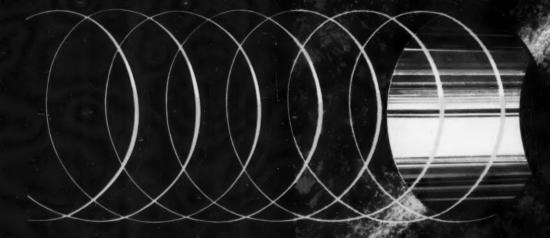
LINE BORING

STUB BORING

COUNTERBORING

ANGULAR BORING

FACE MILLING



END MILLING

ANGULAR MILLING

DRILLING

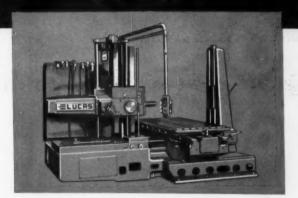
REAMING

TAPPING

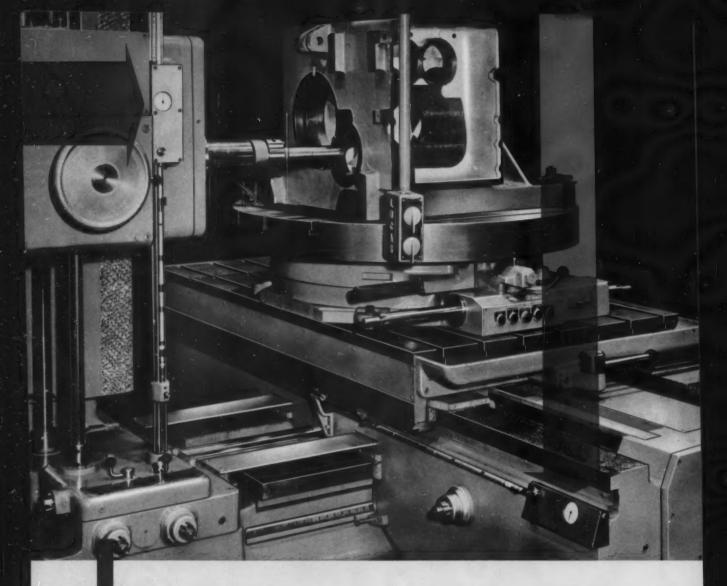
THREADING

#### Automatic power positioning with Lucas precision

For production or faster completion of a single piece: locates head and table to predetermined settings for boring operations. No time wasted on jigs or fixtures in drilling, reaming and tapping. Lucas versatility, precision and time saving are the keys to Lucas profitability. Lucas Machine Division, The New Britain Machine Company, Cleveland, Ohio.

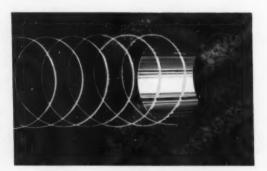


LUCAS OF CLEVELAND

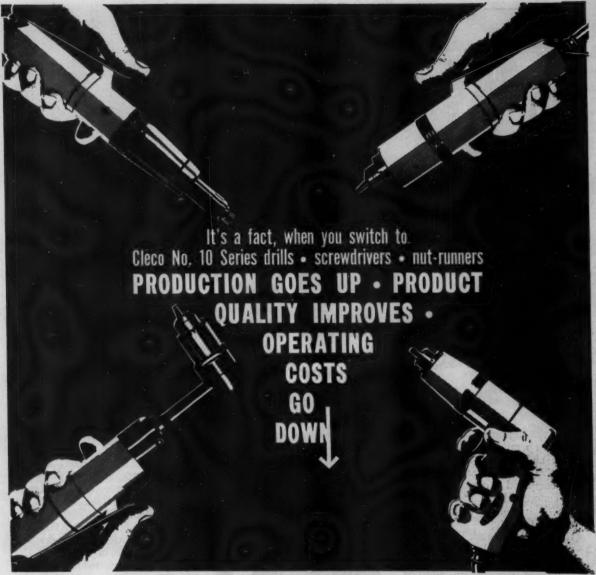


#### Automatic repeat settings accurate to ± .0001

Lucas Automatic Power Positioning operates at rapid traverse to locate head and table, entirely independent of operating feed rates—thru a system of end measuring rods and micrometer dial indicators. Upon starting the positioning cycle the machine does the precision setting automatically. Would you like a complete Lucas Catalog? Lucas Machine Division, The New Britain Machine Company, Cleveland, Ohio.







Here's why:

Reduce parts inventory. By using identical parts throughout the series (where feasible), and by designing the tools with built-in interchangeability features, Cleco has made it possible for you to simplify and reduce parts inventory.

Cost less to operate. No. 10 Series motors are more powerful, yet actually require less air per h.p. output. Well-balanced, and easy-to-handle, these tools are constructed of heavy duty material (high quality Ni, Cr, Mo alloy steel pinion and planet gears, for example) that can really take the demolishing punishment of high production operations. Friction-free clutch permits longer, much longer periods of maintenance-free operation.

Speed production, while improving quality con-

trol. No. 10 Series Drills and Screwdriver — Nut-Runners have design features that reduce time lost and rejects. No. 10 Drills: are equipped with 3-idler planetary gear trains for all gear reductions; have a low noise level; and develop ½ h.p. Drill speeds range from 500 to 20,000 r.p.m. No. 10 Screwdriver — Nut-Runners are available in speeds from 500 to 5,000 r.p.m. Equipped with a no-drift locking device, No. 10 Screwdrivers have unequaled torque holding ability. They cannot over-torque, strip threads, crack plastic, or damage screw heads.

You will not believe that these tools could possibly have so many positive advantages until you see them for yourself, so contact your local Cleco® representative for a no-obligation demonstration. For

specifications and literature, write:



A Division of REED ROLLER BIT COMPANY P. O. BOX 2119 . HOUSTON 1, TEXAS, U.S.A.

IN CANADA: Cleco Pneumatic Tool Company of Canada, Ltd., 927 Millwood Road, Leaside (Toronto), Ontario



Fig. 1. Precision rotary gear-shaving machine announced by the Michigan Tool Co.

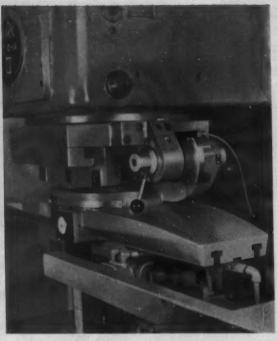


Fig. 2. Compact attachment applied to gear-shaving machine for crown, taper, and fine lead adjustment

#### Michigan Precision Rotary Gear-Shaving Machines

A line of "870 Mark II" rotary gear-shaving machines featuring easier operation, greater compactness and rigidity, increased productive life, and greater precision (as compared to preceding models) is announced by Michigan Tool Co., Detroit, Mich. The line consists of three types-underpass, internal, and universal. The universal model permits selection at will of underpass, modified underpass, or transverse shaving. In addition, there are three sizes of machines for handling gears up to 8, 12, and 18 inches in diameter, respectively (up to 12 inches for internal gears).

The ease with which the Mark II (Fig. 1) can be shifted from one size or type of gear or one processing method to another is one of its outstanding features. The majority of machine settings are dial-controlled. By setting the appropriate dials and graduated scales, the universal machine will shave by underpass, modified underpass, or the transverse shaving method, the selection usually depending on gear and cutter widths. The rate of crossed-axis feed is dial-controlled, as are vertical feed rates for trans-

verse shaving, length of transverse reciprocation, and length of work travel. A single hand crank is used for either raising or lowering the setting of the knee or for adjusting the crossed-axis setting. A built-in, dial-indicator type vernier is provided for fine lead adjustment. To set for the desired amount of



Fig. 3. Switches on electrical panel of machine in Fig. 1, for controlling three available processes

crown or taper, it is only necessary to release two locks and set the crown/taper head to the desired position as indicated by a pointer and precision scale. Only one compact attachment, shown in Fig. 2, is required to allow gears to be either or both crowned or tapered during shaving. The dial scale at right center is for taper setting and the built-in vernier at left is for fine lead adjustments. By means of a dial, feed rates of 1/2 inch to 10 ipm are easily selected to suit work conditions, thus providing opti-mum feeds for both fine and coarse pitches.

All controls and adjustments are easily accessible from the outside of the machine. Gear-face widths up to 5 inches can easily be shaved with the Mark II. The automatic air-operated positive up feed, located in the lower base, has been designed for faster operation and easier setup. The range is from 0 to 0.040 inch in increments of 0.001 inch. There is a choice of four fine up feeds, ranging from 0.0005 to 0.002 inch per stroke, obtained simply by setting a control pointer and two counters located back of the front door in the machine base.

(Continued on page 282)



Deep draw body parts were the bottleneck when presses for the job couldn't deliver more than 7 fender draws per minute. So Danly supplied a double-action press equipped with a DANLY 2-SPEED CLUTCH that automatically speeds up approach and return of the slides, but keeps draw speed safe and slow. The rate was raised to 10 draws per minute without speeding up the critical drawing action. Output jumped from 420 to 600 parts per hour...

a healthy 43% improvement.

And, typical of Danly equipment, both press and clutch have performed without a single interruption in output for maintenance. Another example

of Danly ability to solve metal stamping problems with dependable, versatile equipment ... this time

with a low-inertia, 2-speed clutch that makes a top-notch press even better!

Danly manufactures a complete line of mechanical presses, in capacities from 25 tons to 4,000 tons ... and up. Send for your copy of the Condensed Catalog of Danly

Presses and ask for detailed information on The DANLY 2-SPEED CLUTCH... NOW.





DANLY

DANLY MACHINE SPECIALTIES, INC., 2100 S. LARAMIE AVE., CHICAGO 50, ILLINOIS

MACHINERY, June, 1960

For more data circle this page number on card at back of book

## NEWI

# Linde SIGMATIC Welders



**SWM-13** cart-mounted unit with separate control cabinet rolls readily over hoses, minor obstacles, slings easily from adjustable handles.



SWM-12 sled-mounted unit with separate control cabinet passes easily through small openings, can be slung from rigid tubular handles.

## for All Mig Welding Jobs



SWM-11 features compact mounting of wire feed unit and wire spool on angular welded steel structure; combination continuous-fusion and spot-welding unit, SWM-11-S, is also offered.

Linde's new "Sigmatic" line gives you the most adaptable and versatile mig welding equipment available today. With one of these units, you can weld virtually any metal, in almost any thickness. You can use wire from .020 in. to 3/32 in. diameter (including cored wire) and any shielding gas you select.

Versatility is engineered into the "Sigmatic" line. On the SWM-11, you can change from horizontal to vertical wire feed in minutes. With any unit, you can use conventional "spray-arc" or the LINDE "short-arc" process which has proved so successful on thin steels. Dual-purpose units are available which handle both spot welding and continuous fusion welding.

Several styles of torches are available, ranging up to 500-ampere capacity. Control cabinets are designed and wired for maximum ease of service and for internal addition of special operating features selected to fit your needs.

The same development and laboratory facilities that planned and built this equipment are available for help in applying it to your welding problems. For information on a demonstration see your LINDE representative. Or write for catalog F-1372, Dept. MY-06, Linde Company, 270 Park Avenue, New York 17, N. Y.

COMPANY

UNION CARBIDE

"Linde", "Sigmatic", and "Union Carbide" are trade marks of Union Carbide Corporation.

Here also are located the rapidup-feed control knob and dial with an instruction plate providing the simple setup information. Counters for fine up feed and finishing (nofeed) passes are on the door of the electrical panel.

Switches on the electrical panel for control of feed for the three processes available in the machine are shown in Fig. 3. The switch at the left locks in the automatic upfeed for transverse shaving and locks it out for underpass work. The right-hand switch sets the rate of feed per stroke. The first large dial sets the number of fine-feed strokes, the lower dial the number of finishing strokes (without feed).

Modular construction has been used throughout. This simplifies maintenance, as assemblies are interchangeably replaceable. All gears and bearings operate in sealed-pump type reservoirs, with visual sight gages. A central system lubricates all ways and miscellaneous moving parts. The standard machine will be supplied with the following motors: 2-hp, 1800-rpm for main drive; 1/3-hp, variable-speed for traverse feed; and 1/0-hp, 3600-rpm for coolant.

Circle 587 on Readers' Service Card

"Cylinder King" Honing
Machine

A completely new method for resizing cylinder blocks employing its recently developed "Cylinder King" power-stroked vertical honing machine has been introduced by Sunnen Products Co., St. Louis, Mo. The floor-to-floor time for honing a V8 cylinder block on this machine is thirty-three minutes. This total time includes setup, ridge removal, stock removal within 0.002 inch of desired oversize, finish honing to final size, gaging, and removing the resized block from machine.

One of the important features of this method is that cylinders can be resized to a minimum standard oversize because the honing tool takes its alignment directly from the original unworn portion of the cylinder. As a result, over 80 per cent of all blocks will clean up completely at 0.020 inch oversize, thus doubling the useful life of the block—a big asset to shops specializing in fleet maintenance and custom engine rebuilding.

If a badly worn block should not clean up, it is a simple matter to hone to the next desired oversize, which requires no extra setup. The stock removal rate is 0.010 ipm, or an average of two minutes per cylinder, including the ridge removal. Accuracy of the resized cylinder is guaranteed to be within the manufacturer's specifications of roundness, straightness, and surface finish.

Circle 588 on Readers' Service Card

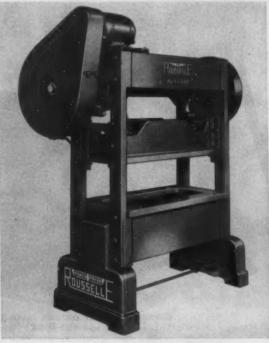
#### Double-Crank Presses

Service Machine Co., Chicago, Ill., has announced a 40-ton Rousselle press designed especially for handling wide rolls or sheets of stock including plastics, paper, leather, and sheet metal. Four long ways provide a rigid four-corner ram support which makes this press adaptable for steel-rule dies and a variety of multiple punching. The unit is available in three sizes with bed areas up to 6 feet. Standard die space is 12 inches but this can be increased up to 24 inches. Presses can be equipped with electrically controlled "Econo-Air" friction clutch to provide rapid, shockless starting and stopping at higher speeds.

Circle 589 on Readers' Service Card (This section continued on page 266)



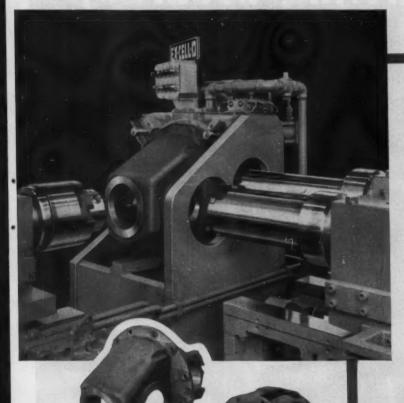
Sunnen honing machine for resizing cylinders



Rousselle straight-side double-crank press

## Ex-Cell-O Custom Machines Specialize

in Difficult Jobs!



♠ HEAVY-DUTY BORING—Custom Boring Machine uses three heavy-duty Ex-Cell-O Precision Spindles to simultaneously finishbore four holes and bore-and-face a fifth hole in this 75-pound cast-iron housing in a 4½ minute cycle. Diameters are about 6"; tolerances are held within .001".



MULTI-DIAMETER BORING—In a single cycle, the long boring bar on this Custom Machine line-bores two holes while shorter bar below it bores a third diameter, and small spindle in foreground bores a dowel hole in this huge clutch and gear housing.

SEE EX-CELL-O'S BOOTH 946.



HIGH PRODUCTION—Aluminum transmission case shown above is turned 90°, rolled over 180° as it passes through a 24-station Custom Machine. Automatic operations include precision boring, facing, chamfering, radial milling, tapping, trepanning, air gaging and flushing. Output is 124 parts per hour.

Whether you have a simple job that must be done faster and more accurately, or complex work that requires multiple machining operations, an Ex-Cell-O Custom Machine may be just the answer you've been looking for . . . the economical solution to a difficult production problem.

See your Ex-Cell-O Representative, or contact Ex-Cell-O's Machinery Division in Detroit for details on the limitless applications of Ex-Cell-O Custom Machines.

EX-CELL-O FOR PRECISION

Machinery Division

MANUFACTURERS OF PRECISION MACHINE TOOLS + GRINDING AND BORING SPINDLES - CUTTING TOOLS + DRILL JIG BUSHINGS - TORQUE ACTUATORS - CONTOUR PROJECTORS - GAGES AND GAGINE EQUIPMENT - CRANITE SURFACE PLATES - AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS - ATOMIC ENERGY EQUIPMENT - RAILROAD PINS AND BUSHINGS - DAIRY AND OTHER PACKAGING EQUIPMENT

EX-CELL-0

## Fastener driving accuracy-

CP twenty spindle Multi ranner drives transmission oil pan sciews with



PRECIMATIC TOOLS - AIR COMPRESSORS - ELECTRIC TOOLS - DIFSTI INCIDING - HYDRAULIC TOOLS - MACHINA BURDES - AVAITON AS LESCANIES

## an ASTME Show highlight

## CP demonstrates latest in "One-Shot" Torque Control Screwdrivers and Nutrunners

The CP Booth at the ASTME Show in Detroit really packed them in. Production men responsible for assembly, quality control and standards learned first-hand facts about "one-shot" Torque Control tools. They watched new hand-held tools and multi-spindle units prove their consistent accuracy...saw a new Torque Analyzer prove its ability to test and calibrate Torque Control power tools. They proved for themselves, that CP Screwdrivers and Nutrunners can hold the specific torque settings so essential on

today's fast-moving production lines.

The CP exhibit featured the most extensive line of standard "one-shot" straight and angle Screwdrivers and Nutrunners, Multiple Motors and Impact Wrenches ever offered to the assembly industry.

If you missed the show...don't miss the facts. To get the full story on CP "One-Shot" drivers for hand-held or multi-spindle job requirements — use the handy coupon below.



NEW CP-200 Torque Analyzer tests and colibrates torque control power tools.



NEW CP-3017 Dial Tork Nutrunner, the only instantly adjustable power tool that inspects as it drives.



Screwdrivers for large or small fasteners.



E-SHOT" TORQUE



GET 12 PAGES OF STRAIGHT FACTS ON "ONE-SHOT" TORQUE CONTROL TOOLS. USE THIS COUPON TO MAKE SURE OF YOUR FREE COPY.

Chicago Pneumatic Tool Co., Dept. M-60 8 East 44th Street, New York 17, N. Y.

Please send a copy of SP-3266, your 12 page color booklet on "One-Shot" Torque Control Screwdrivers, Nutrunners, Angle Nutrunners, Multi-Runner Motors and Torque Analyzers.

Name

Company

Address\_\_\_\_

City\_\_\_\_\_State\_\_\_\_



Delta power-feed drill press introduced by Rockwell Mfg. Co.

#### Delta Power-Feed Drill Presses

A line of 20-inch power-feed drill presses has been introduced by Rockwell Mfg. Co.'s Delta Power Tool Division, Pittsburgh, Pa. This machine is available in eighteen models, including bench, floor, multiple-spindle, and overhead track-mounted styles. It has a connection from which automation devices such as rotary tables may be controlled and synchronized with spindle operation. The power feed limits the operator's work to loading, unloading, and actuating the tool, giving him time to operate other tools or prepare the next piece during the machining cycle.

The power feed features a unique, front-mounted pilot-wheel control mechanically integrated with the clutch control, allowing one-hand operation. There are four feed ratios—0.004, 0.006, 0.009, and 0.012 inch per revolution—with each of five spindle speeds. The same pilot wheel is used for manual feed and no adjustments are needed to change to manual application. For rapid approach, the cutting tool may be moved to the work manually before the power feed is actuated.

A "come type" clutch permits the use of power feed on a production basis through a wide range of hole diameters. By a simple torque adjustment, the operator switches from a machine that delicately handles small drills in the 1/16-inch range, to a machine delivering 1000 pounds of thrust for drilling holes up to 1 inch in diameter in cast iron. The power feed includes a full 6-inch spindle travel, providing ample capacity

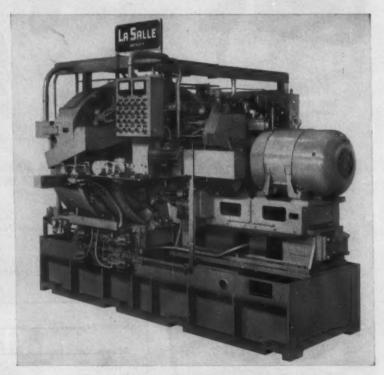
for drilling, counterboring, and reaming of large work; heavy-duty spindle 31/32-inch in diameter; easily read depth gage; and quick-release motor mount which permits easy belt changing with no possibility of damage to the specially designed, steel-reinforced V-belt. The power-feed mechanism may be added to any Delta 20-inch drill press in the field without any adaptations.

Circle 590 on Readers' Service Card

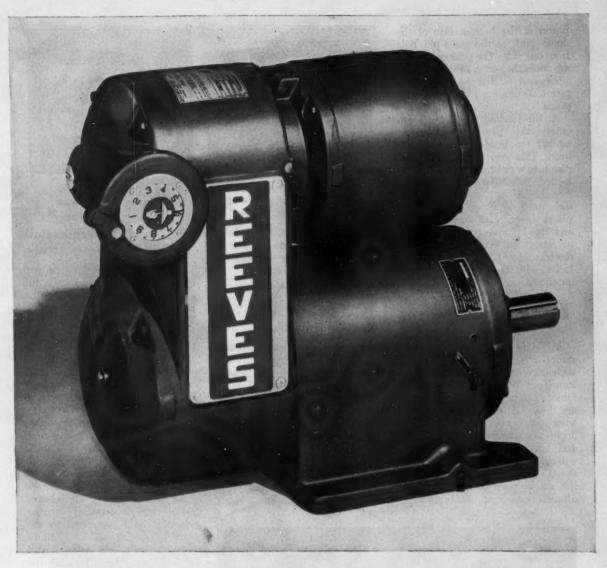
#### "Pistonette" Machine for Processing Engine Pistons

A versatile six-station trunnion type unit called the "LaSalle Pistonette," designed to process V-12 and V-8 engine pistons, has been built by LaSalle Tool, Inc., Detroit, Mich. This machine requires only 108 square feet of floor space, with over-all dimensions of 12 feet by 9 feet by 6 feet. It is designed to handle pistons for trucks, buses, tractors, heavy-power equipment, and marine engines. It processes three different pistons and is designed to facilitate retooling.

The machine center-drills the dome end of the piston; drills, chamfers, and reams two process holes in the weight boss; and faces the weight boss for locating purposes. When operating at 100 per cent efficiency, it will handle 514 pistons per hour. The automatic loading mechanism receives the pistons, head end down, from a belt conveyor. The piston is prepositioned with an interference bar against the flatted portion on the outside of the wrist-pin hole. A positioning arm engages the



Six-station trunnion type piston-processing machine built by LaSalle Machine Tool, Inc.



#### **REEVES Vari-Speed Motodrive**

#### packed with new flexibility . . . broader production use

Now available in this compact design, Reeves Vari-Speed Motodrives deliver 2:1 through 10:1 speed variation, 1.8 through 4660 rpm ... ¼ to 20 hp.

The infinitely variable output speeds meet almost every production need.

You can get these drives with output shaft

on same or opposite side of the motor; vertical, 45°, horizontal or trunnion models; no reducer, and single, double or triple stage reductions . . . hundreds of space saving assemblies. Reeves provides a full range of modifications, accessories, and manual, remote or automatic controls.

Write today for complete data on sizes 100-500 (¼-20 hp) and sizes 8000 (25-40 hp) REEVES PULLEY COMPANY
Division of RELIANCE ENGINEERING CO.

COLUMBUS, INDIANA
In Canada: Reeves Drives + Taranta + Mantreal

REEVES

piston at the bottom side of the dome and in the wrist-pin hole from one side. The positioning arm advances the piston to the load position and rotates the axis of the piston 90 degrees for loading purposes.

At the loading position an arm enters the piston and locates against the inside surface of the head. This arm will advance the piston to a positive stop. A springloaded, jack-locked pad in the fixture backs up the piston during the machining operation. The piston is clamped in the fixture and the loading arm is retracted to repeat its cycle. This unit is electrically controlled and interlocked with the machine cycle. The automatic unloading mechanism





Fig. 1. (Left) Vizi-Disc as it appears at rest. Fig. 2. (Right) In use, the Vizi-Disc affords the operator a full view of the grinding area

is pneumatically operated and electrically controlled. An adapter enters the fixture after the unclamping and ejects the piston.

Circle 591 on Readers' Service Card

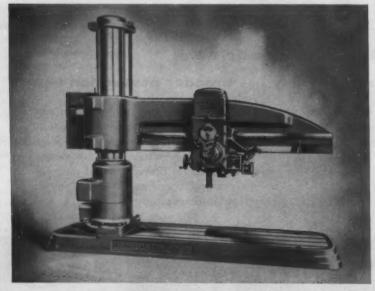
#### Radial Drill Designed for Medium-Duty Work

A "Maxi-Speed Hole Wizard" radial drill is now available in a wide range of sizes from the American Tool Works Co., Cincinnati, Ohio. These medium-duty units are designed to meet the variable work requirements of maintenance departments, manufacturing plants, and structural-steel shops. They will drill, face, and accurately bore at high speed. Tapping operations can also be performed without additional equipment. Holes up to 2

inches in diameter can be drilled and tapped in steel. With proper feeds and speeds, the capacity can be increased.

The machines are available in column sizes from 13 through 19 inches in diameter, with arms from 5 to 14 feet in length. In addition to manual feeds, the head provides twelve spindle speeds with three optional ranges, plus six power feeds in two ranges.

Circle 592 on Readers' Service Card



Medium-duty, "Maxi-Speed Hole Wizard" radial drill announced by American Tool Works Co.

#### Grinding Disc Permits Full View of Working Area

Disc grinding can now be performed with the work area in full view of the operator. To get this result, the Behr-Manning Co., Troy, N. Y., a division of the Norton Co., Worcester, Mass., has developed a special, fiber-backed abrasive disc of modified shape, called the "Vizi-Disc." This disc has two parallel straight sides with a radius at each end, as shown in Fig. 1. As such a "disc" rotates, the surface being ground is visible for a full inch from the outer edge of the disc as shown in Fig. 2. Grinding is said to be faster with this abrasive disc because it need not be moved away from the work point for frequent inspection. Dwell time is reduced because grinding can be confined to the exact area to be finished. Contour work and blending of welds can be done accurately. Because the actual grinding is intermittent, the metal remains so cool that burning and heat distortion are eliminated.

The Vizi-Discs (for which patent protection is being sought) are available in 7- and 9-inch sizes. They are surfaced with the sharp-cutting Metalite, an aluminum-oxide abrasive, in the standard range of grit sizes. In use, they are supported by sisal-reinforced rubber backup pads slightly smaller than the abrasive disc. Heavy-duty pads of the same construction are available for aggressive grinding. Pads are surfaced with a diamond grid pattern to prevent slippage. Accessory kits contain a pad, a retainer nut, and a wrench.

Circle 593 on Readers' Service Card (This section continued on page 272) Tough tapping jobs get a "lift"...



#### For Specific Materials

GREENFIELD Fast Spiral Fluted Taps provide trouble-free tapping of blind holes in ductile and stringy materials. Where straight flutes become clogged with long stringy chips, spiral flutes aft and carry the chips out before they have a chance to ball up and wedge in the flutes. Spiral flutes reduce friction and eliminate a major cause of tap meanage.



#### For Specific Jobs

Fast Spiral Fluted Taps are espeially useful in cutting holes which are interrupted by slots, keyways or other gaps. The tap remains steady at all times because all of the tap lands are in contact with the sides of the hole even when a portion of a land is spanning the open space.

.. with

Greenfield
Fast Spiral Fluted
Tans

WANT TO LEARN MORE
ABOUT GREENFIELD
FAST SPIRAL FLUTED TAPSS
CONTACT A GREENFIELD
FIELD ENGINEER
THROUGH YOUR LOCAL
GREENFIELD DISTRIBUTOR.

GREENFIELD TAP & DIE Greenfield, Massachusetts



#### NEVER BEFORE-UP FRONT CONTROL WITH ONE HAND OPERATION

Unique pilot wheel control is mechanically integrated with the clutch control, allows operator to engage power feed with a simple wrist movement of one hand. Without any adjustments, operator can use rapid manual approach then power feed, skip drilling technique, straight power feed or straight manual feed. There are four feed ratios—.004, .006, .009 and .012 ipr—with each of five available spindle speeds.

#### NEVER BEFORE-SUCH A COMPLETE CHOICE OF MODELS



Floor model



Bench model



Overhead model



Multiple spindle model

#### ROCKWELL ANNOUNCES ...

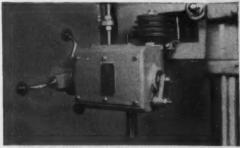
## NEW POWER FEED

## on famous DELTA 20" drill presses



#### NEVER BEFORE—"JOB TAILORED" DRILL POINT PRESSURE

A lathe-type cone clutch enables operator to adjust drill point pressure from 0 to maximum capacity of machine to permit power feeding on a production basis through a wide range of hole diameters. It furnishes power and thrust for drilling holes up to 1", yet delicately handles drills down to  $V_{16}$ " diameter. Torque sensitive adjustability feature stops feed when overloaded—avoids drill breakage.



#### NEVER BEFORE—REMOTE CONTROL AND AUTOMATION

Actuating plunger, an extension of the clutch shaft, permits remote control which frees operator from manual effort. The power feed can be electrically, hydraulically, pneumatically, or mechanically interlocked with other machines or synchronized with devices such as rotary tables, clamps and work feeds for semi or full automatic operations.

Now Delta brings you advantages NEVER BE-FORE AVAILABLE on a standard drill press—with the most advanced development in mechanical power feeds. Every model in the new Delta 20" drill press line offers power feed that gives you: a front mounted pilot wheel for effortless one hand operation; infinitely adjustable drill point pressure; built-in feature that permits remote control or interlocking with automation devices.

With the flexibility of feeds afforded by "flick of the wrist" control, operator's work is limited to loading, unloading, and actuating the tool. You get the adaptability of a power tool with the ruggedness, precision and capacity of a machine tool. Capable of handling production metalworking jobs done by machines costing much more, these new Delta power feed drill presses provide a simple, low cost method of increasing productivity and improving drilling quality.

Thoroughly tested through a rugged trial of 750,000 drilling cycles, Delta's new power feed line offers many other outstanding features and NEVER BEFORE AVAILABLE benefits that vou cannot appreciate unless vou see them demonstrated IN ACTION. Let your Delta Industrial Distributor show you how the 20" power feed drill press can help you cut costs (he's listed under "TOOLS" or "MACHINERY" in the Yellow Pages). Meanwhile, for FREE brochure giving details and specifications plus information on how to add New Power Feed to your present Delta 20" drill press, write: Rockwell Manufacturing Company, Delta Power Tool Division, 614F N. Lexington Avenue, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada. Ltd., Box 420, Guelph, Ontario.

#### DELTA INDUSTRIAL TOOLS

another fine product by



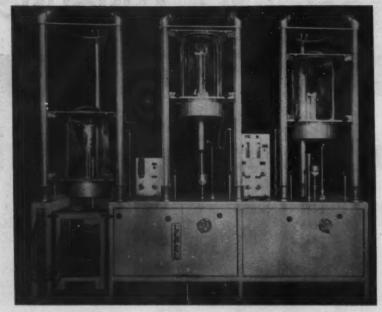
ROCKWELL

#### Induction-Heating Equipment

The Lepel High Frequency Laboratories, Inc., Woodside, N. Y., has recently developed a line of production fixtures to braze metal assemblies under a controlled atmosphere by induction heating. The reducing atmosphere prevents oxidation of the work during heating. thereby eliminating the need for flux. The joints produced with these units are said to be uniformly sound and free of residual or entrapped flux. Combining induction heating, which provides rapid, highly localized heating, and a controlled atmosphere, these units serve to join copper-alloy, steel, and stainless-steel assemblies on a production basis.

The accompanying illustration shows two fixed working stations and one caster-mounted heating station. The latter can be quickly unlatched, the water-cooling lines unplugged from the main bench, the bell jar raised, and the whole assembly rolled out. Another heating station with a new assembly is then rolled in, hooked up and ready for heating so that a minimum of time is lost. One of the outstanding features of this unit is the rapid change-over from one job to another.

The bell-jar fixtures can be made in any combination of fixed and



Lepel controlled-atmosphere induction-brazing equipment

removable stations. The three work stations are operated from a single induction-heating generator. The heating cycle is automatically con-

trolled at each station by a preset timer, thus enabling one operator to work more than one station.

Circle 594 on Readers' Service Card

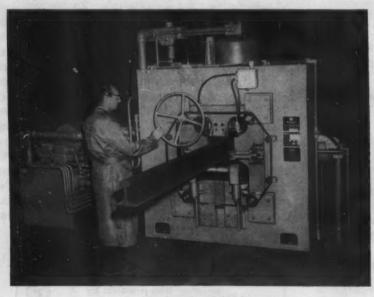
#### Hydraulic Press for Straightening Rails Automatically

The Hydraulic Press Mfg. Co., division of Koehring Co., Mount Gilead, Ohio, has brought out a hydraulic press designed to automatically straighten bends in railway rails having no more than 6- to 8-foot radii. By putting an outboard sensing device on the exit side of the press, it is possible to straighten longer bends by straightening at 6- to 8-foot intervals.

The press has four cylinders, two with 200-ton and two with 80-ton pressure capacities. The 200-ton cylinders operate vertically, while the 80-ton cylinders operate horizontally. All cylinders are located in the same frame and operate through the same center lines.

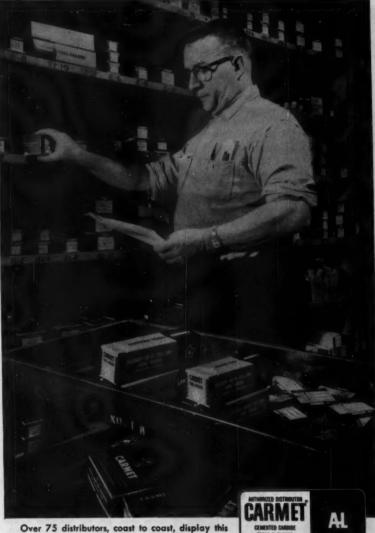
The rail being straightened is fed through the press by a conveyor system. The directions of bends and their location in the rail are indicated automatically. When the bends are located, the conveyor automatically stops, the proper straightening ram is energized, and the rail is straightened. Equipment includes pressure-blocks which are adjustable for operation on 30- to 51-inch centers.

Circle 595 on Readers' Service Card (This section continued on page 274)



H-P-M hydraulic rail-straightening press

Off-the-shelf
delivery of Carmet®
Carbide Tools from
your local
CARMET
Distributor



Over 75 distributors, coast to coast, display this sign—service in your own local area.

Keep your inventory of Carmet Carbide Tools at a comfortable level. Keep your working capital free for other needs. Your Carmet distributor carries the load—that's how he's set up to do business.

He carries your needs from the complete line of Carmet Carbide Tools in all grades and every style. He is geared to deliver your orders quickly—a phone call gets action.

And if you get in a production jam, special service is his middle name. Remember, your Carmet distributor knows carbide tooling—with the help of the local Carmet technical man, you get all the help you need.

Your Carmet distributor handles the best Carbide Tools and backs it with the best service! Allegheny Ludlum Steel Corporation, Carmet Division, Ferndale, Detroit 20, Michigan.

CARMET



EMENTED CARBIDE . DIVISION OF ALLEGHENY LUDLUM

1800

#### Vane-Operated Limit Switch and Drum Switch

A vane-operated limit switch, one-third smaller in size than the previous model, which can be front- or top-operated and has a vane opening that is much wider, has been announced by the General Purpose Control Department, General Electric Co., Schenectady, N. Y. The switch, Fig. 1, is designed primarily for use in controlling machine travel.

Initial forms will be available in either front- or top-operated models, normally open or normally closed, single-pole contacts, with or without an indicating light. A mounting plate with either form can be rotated 90 degrees to permit flexible mounting arrangements. Encapsulation protects internal components from external fluids and dirt. The switch is said to be capable of over 250,000,000 operations with General Electric static control.

Armless, leverless, and shaftless, the new magnetic device is energized by the passage of a separate

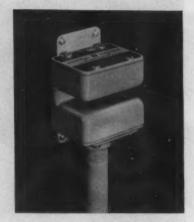


Fig. 1. G-E vane-operated limit switch

metal vane through a recessed slot in the switch. Attached to the mechanism to be controlled, the vane disturbs a magnetic field balance which causes hermetically sealed contacts to operate.

Operation of the precision device is said to be consistent within plus or minus 0.0025 inch, providing that the path of the vane is maintained. Response time of the



Fig. 2. G-E drum switch for electric motors

switch is approximately 0.001 second. Normal contact rating is 115 volts alternating current, 0.2 ampere, make or break. Maximum rating of 115 volts alternating current, 0.75 ampere is possible. Of single-pole, single-throw design, the switch meets JIC requirements.

Size of the top-operated model, without the indicating light, is 2 11/16 by 2 3/4 by 2 5/8 inches, exclusive of the mounting plate. The operating vane can be any magnetic iron or steel about 1/16 to 5/16 inches thick and 1 1/2 inches wide.

The drum switch, Fig. 2, is designed for control of single-speed electric motors up to 2 hp. Visible contacts; positive spring-action handle; and large, front accessible, screw type terminals are features of this new switch. Operation of the spring-action handle causes contacts to open or close, providing starting, stopping, or reversing of a motor. Shipped as a maintained-contact model, the drum switch can be readily changed in the field to momentary contact.

A wrap-around cover provides 180-degree accessibility to internal components during installation. Two conduit openings at bottom of the enclosure permit separate openings for incoming and outgoing leads. Over-all dimensions, including the handle, are 45/8 inches high, 29/16 inches wide, 45/8 inches deep. Applications include use on lathes and other small machinery.

Circle 596 on Readers' Service Card (This section continued on page 276)

## Protection for Man and Machine FUTURMILL'S" Way-Life" WAY COVERS



Way-life covers are lightweight—yet very strong. The extruded aluminum sections are ribbed full length with a full length ball and socket type interlocking hinge.

SAVE THE WAYS—"Way-Life" covers keep chips, grit, dirt and other foreign matter out of the ways and feed mechanisms. The solid aluminum, interlocking sections will absorb a considerable amount of shock and prevent damage to the ways—such as caused by accidental dropping of heavy objects on the ways.

WORK WITH SAFETY—The strength and rigidity of "Way-Life" covers permit operators to walk safely on top of the cover, making machine servicing and job set-up safer and easier. It is impossible for personnel to fall through the cover or become caught or trapped between the ways.

CUT COST & MAINTENANCE—Unlike fabric, rubber, plastic, sheet metal, foil, telescopic, or accordion type covers, "Way-Life" covers will not burn, warp, tear, rust or buckle. They require no auxiliary power since the cover is motivated by table or column movement. No special servicing is necessary.

DRESS UP YOUR SHOP—"Way-Life" covers are full dress—armored protection for any machine . . . a complement of utility—economy and cleanliness for any shop.

Write: FUTURMILL, Inc. 6360 Highland Road Pontiac, Michigan



#### With Extras . . . At No Extra Cost

- METAL PISTON ROD SCRAPER—protects rod packing, cylinder bore and rod surface by removing all foreign particles.
- NEW "SUPER" CUSHION for air or METALLIC SELF-ALIGNING MASTER CUSHION for oil.
- HARD CHROME PLATED CYLINDER BORES AND PISTON RODS for greater protection and reduced wear.
- ONE PIECE PISTON assures better alignment, longer bearing and packing life.
- 5. FORGED SOLID STEEL HEADS throughout entire line.
- PILOTED PACKING GLAND with extra long bearing for additional strength and support to piston rod.
- 7. NO TIE-RODS TO STRETCH—gives you 360° port rotation . . . less space used . . . full strength.
- STREAMLINED DESIGN...operating pressures to 200 PSI, air; 1,000 PSI oil, non-shock.

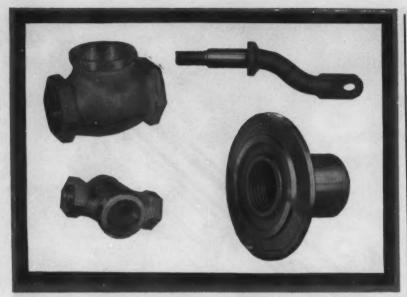
## T-J Spacemaker

#### for longer, more efficient cylinder service

You too-can reduce replacement expenditures—lower maintenance costs with the T-J Spacemaker cylinder line. Designed and engineered for ruggedness, and accuracy of operation, the Spacemaker assures longer, uninterrupted operation.

The T-J Spacemaker eliminates tie-rods, gives greater strength, saves space... and reduces costs in all push-pull operations. Immediate delivery in a complete range of styles and capacities... air or oil. Write for Bulletin SM 155-4, today. The Tomkins-Johnson Company, Jackson, Michigan.



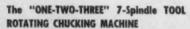


# PLAN PRODUCTION OF PARTS LIKE THESE and MANY OTHERS . . . for speed, convenience and economy on GOSS & DeLEEUW AUTOMATIC CHUCKERS

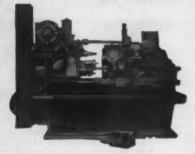


#### 4-SPINDLE TOOL ROTATING CHUCKING

available in three sizes, combine various turning, boring, facing, threading, multiple drilling and tapping operations on a wide range of single-ended parts.



can complete in one operation as many as three ends of valve bodies, plumbing fittings, etc. eliminating secondary operations.





Sond samples of your work for time estimates. Ask for illustrated literature.

#### GOSS and DE LEEUW

MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

#### Lincoln Electric Expanded Motor Line

The Lincoln Electric Co., Cleveland, Ohio, has expanded its line of three-phase, squirrel-cage induction motors to include sizes from 1/2 to 125 hp. "Multiguard" protection, a specially compounded thermosetting plastic, is used to encapsulate and impregnate the motor stator on all motors in this line. This feature is said to be a valuable asset wherever applications normally call for premium-priced total enclosure.

In addition to increasing motor sizes, a number of design modifications have been made to further



Redesigned motor of expanded line announced by Lincoln Electric Co.

improve motor performance. The die-cast aluminum rotor is supported by doubly shielded "Super Conrad" type bearings. The bearing and fabricated-steel end-bell design permit operating the motor with the shaft in either the horizontal or vertical position. Bearing life is increased with a sealed housing having a reservoir for grease storage and facilities for regreasing. A positive housing seal preventing entry of destructive contaminants is achieved by mounting a neoprene slinger on the shaft against the exterior side of the end bell and fastening specially designed dust caps to the inner face of the housing.

The entire motor (including the



DENISON Multipress installation pays off for BARBER-COLMAN with faster, simplified small motor assembly that...

# CUTS COSTS



DENISON
4-TON HYDRAULIC
MULTIPRESS is used by
Barber-Colman to
assemble low-cost precision AC motors.



PREDICTED cost cuts have been confirmed by the installation of three Denison Multipresses at Barber-Colman Company in Rockford, Illinois.

Justified by MAPI (Machinery and Allied Products Institute) formula analysis, these presses operate in a line connected by belt conveyors. Semi-automatically, Multipresses perform bending, staking, aligning, compressing, riveting and stamping operations in the production and assembly of small precision electric motors.

In addition to more efficient handling of production functions, other Multipress bonus benefits include—product uniformity... reduced scrap loss...rapidly adjustable stroke length and pressure for faster, simpler set-up...longer die life to lower tooling costs and downtime.

Duplicate these savings and bonus benefits in your plant today! Your Denison Production Specialist can show you how with a Multipress Analysis Program that can MAP new savings for you now.

American Brake Shoe Co.

1152 Dublin Road . Columbus 16, Ohio

HYDRAULIC PRESSES
PUMPS · MOTORS · CONTROLS

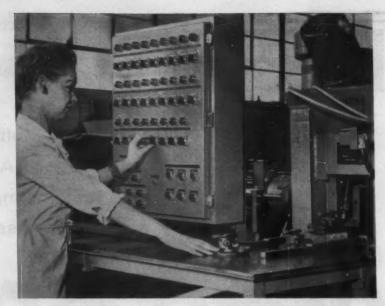
## DENISON HYDRAULIC MULTIPRESS

fabricated steel frame, end bells, and cast-aluminum rotor) is coated inside and out with a vinyl-based primer and an acid-resistant paint. This is said to insure excellent motor performance even under conditions that ordinarily cause rotor freezing on unprotected, open type motors.

Circle 597 on Readers' Service Card

#### Pioneer Machine Processes Fifty-Four Different Parts

A machine with finger-tip control that will completely process fifty-four different carburetor bodies at a rate of 200 parts per hour has been built by Pioneer Tool & Engineering Co., Chicago, Ill., for the Marvel-Shebler Products Division of the Borg Warner Corporation, Decatur, Ill. This in-line transfer machine, requiring minimum setup time, will drill, tap, counterbore, spot-face, ream, lineream and probe all critical holes in the carburetor body. It was developed primarily to reduce operating costs through the use of automatic features.



Finger-tip control of Pioneer transfer machine

Built in block sections, the machine can be easily disassembled to accept new stations. A self-contained hydraulic pump is used to clamp and shuttle work-holding

fixtures. Lights and switches in the control panel shown in the illustration make possible finger-tip control by the operator.

Circle 598 on Readers' Service Card

## FASTER AUTOMATIC CUT-OFF Tubing, Pipe and Bar Stock



Automatic operation — from loading to final cutoff. Handles solid bar stock up to 3" O.D.—tubing up to 8" O.D. Cuts 
any material that can be 
turned. 16 spindle speeds.





The Modern Automatic Cutting-Off Machine and Bar Feeder Combination, shown above, handles random lengths of tubing, pipe and bar stock. With this combination the entire load is fed to the cutting-off machine without attention of an operator. Feeders are available for any maximum length bars. Only one single crank adjustment needed—for stock diameter.

#### WRITE FOR CATALOG

Has complete specifications of all models. Illustrates parts that are being formed, grooved, flanged or chamfered and cut off in a single operation at a high rate of speed. Also describes the automatic feeder, hot spinning machine for sealing ends of tubing, and the Modern Safety Drill Table.

#### MODERN MACHINE TOOL CO.

2005 LOSEY AVENUE Jackson, Michigan

#### Angular-Position Transducer

One of the newest products of the research and development laboratories of the Electronics and Instrumentation Division of Baldwin-Lima-Hamilton Corporation, Waltham, Mass., is an angular-



Lightweight angular-position transducer

position transducer. Designed to provide continuous and accurate measurement of angular displacement, this small, lightweight unit has primary test application in servo systems on aircraft control surfaces, valve positioners, and radar scanners of limited travel.

(Continued on page 280)

MACHINERY, June, 1960

It's a Push-Button World at WILLIAMS

that's why SUPERJUSTABLES® NORK BETTER • LAST LONGER





■ AUTOMATED MACHINING guarantees smooth adjustment, exact fit in every wrench. This million dollar transfer machine was designed especially for Williams' Superjustable® wrench production. A push of a button puts 28 stations in operation... consistently machining to uniformly close tolerances. Fully machined wrench heads are constantly checked on special gauges to further insure perfect fit with sliding jaws, worms, pins and springs. No other manufacturer has this automated equipment to so precisely machine wrenches that work better...last longer.

Send for New Catalog No. 304. Lists over 4530 Stock Wrenches, Tools and Forgings... the Broadest Line of its kind.



J. H. WILLIAMS & CO.

409 VULCAN STREET . BUFFALO 7, NEW YORK

TOOLS of INDUSTRY

Superjustables® are available in regular or locking styles in sizes ranging from 4 to 24 inches, Black or Chrome finish.

PERJUSTABLE" CHROME

The internal element of the device is a high-strength metal beam, on to which are bonded special SR-4

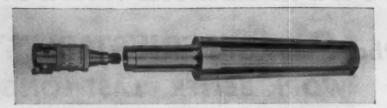
strain gages.

The gages are electrically connected to form a balanced Wheatstone bridge. A constant voltage is applied across opposite corners of the bridge, so that a change in angular displacement of the transducer's input shaft changes the resistance of the gages and will produce a change in output voltage. This last change is measured by an indicator or recorder which can be calibrated in appropriate angular units. Transducers are available in three standard capacities, offering useful ranges of plus or minus 30, 20, and 60 degrees. All can operate on alternating or direct current and have stops to prevent damage from overloads.

Circle 599 on Renders' Service Card

#### Precision-Boring Tool-Holders

M.B.I. Export & Import Ltd., Bronx, N. Y., is introducing a complete line of Kaiser adjustable pre-



Kaiser adjustable precision-boring tool-holder

cision-boring tool-holders, especially designed for jig borers and horizontal boring machines. These tool-holders are now being introduced for the first time on the U.S. market. They have high cutting capacities and are equipped with vernier scales and interchange-able shanks. Tool bits are advanced radially (important when drilling blind holes).

Circle 600 on Readers' Service Card

#### Heavy-Duty High-Pressure Hydraulic Cylinders

Interchangeable, heavy-duty highpressure hydraulic cylinder for 2000-psi (3000 psi-nonshock) operation now being introduced by the S-P Mfg. Corporation, Solon, Ohio. Featuring a compact 1 1/8-inch bore size in its line of twelve sizes with bores ranging through 12 inches, they are available in twenty-three different mounting styles and four different rod ends for maximum flexibility of installation. The cushion adjustment and check both fit flush into the cylinder end-plates and are interchangeable, resulting in greater convenience for adjustment and flexibility in installation. The one-piece pis-



#### HOW TO DESIGN EXCESS WEAR OF MACHINE TOOLS WITH MADISON-KIPP Fresh Oil Lubricators

Machine Tools, Compressors and special machines of all kinds have been kept in top condition for 20 or 30 years or more when equipped with one of 6 models of Madison-Kipp Lubricators.

Fresh Oil Lubrication is automatic, closely measured, constantly fed new oil under pressure for each friction surface to which it is applied.



The Model OL-one of the 6 Models of Madison-Kipp



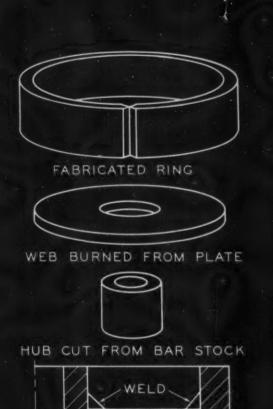
MADISON-KIPP CORPORATION 203 WAUBESA STREET . MADISON 10, WISCONSIN

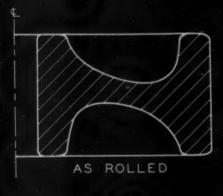
Skilled in Die Casting Mechanics . Experienced in Lubrication Engineering . Originators of Reality High Speed Air Tools

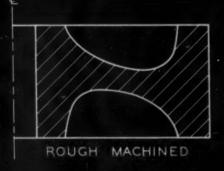
ton has a solid head which eliminates air pockets and allows quick bleeding. Full-area ports also aid in obtaining greater speed and power. The "Clinch-Tite" end seal maintains a leakproof seal at all pressures, since any increase in internal pressure automatically reduces the radial clearance at the pilot fit, eliminating any O-ring extrusion. To help make servicing easier and faster, a quick-change, self-contained cartridge unit is used which is externally removable without loosening any tie-rods, removing the retainer plate, or dismantling the cylinder. Another outstanding development is the use of Heli-Coil inserts as the piston lock, eliminating the use of nuts, lockpins, and other less desirable means of locking the piston on the

Circle 601 on Readers' Service Card

(This section continued on page 282)







#### Why fabricate it?

DESIRED SECTION

(and pay for waste metal, assembly time, welding?)

Bethlehem Circular Forgings come ready for finish machining. Unlike a weldment, there's no fabricating to be done. No assembling. No welding. You save the high cost of all those operations—and the cost of the metal those operations waste.

Cost? Thanks to our Slick Mill (the only one of its kind in the country), the cost of Bethlehem Circular Forgings is low. Even if new tooling is required, orders of 20 or more pieces are economical (dies can be changed in just 15 minutes). Our mill forges and rolls an impression-die forging in about one minute. Because contact time between die and

#### We'll forge it!

(and cut your costs: less metal, no assembly or welding)

work is so brief, and because there's no impacting, low-cost dies can be used.

There you have it. One, important fabrication savings. Two, low initial price. That's why forged circular products consistently cost less than weldments.

Bethlehem Circular Forgings are available in carbon, alloy, or stainless steels, and some heat-resistant grades. 10 to 48-in. OD. 100 to 2,000 lb. As-rolled or rough-machined to specifications. For full details, call or write the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL





Don't let adaptation and compromise determine your gearing specifications. Custom-made gears and gear boxes from Cincinnati Gear are competitively priced—yet, they afford the design engineer full freedom to incorporate the exact transmission components he requires to suit his specific need.

Send for NEW 32-page Technical Brochure



## THE CINCINNATI GEAR CO.

Wooster Pike and Mariemont Ave. Cincinnati 27, Ohio Custom Gear Makers Since 1907

GEARS, good gears only



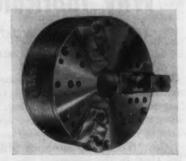
#### Threadwell "Chip-Shape" Tool Bit

General-purpose, long-life tool bit made from a high vanadium analysis, high-speed steel brought out by Threadwell Tap & Die Co., Greenfield, Mass. High resistance to abrasion and high impact strength are inherent qualities said to help make this "Chip-Shape" an outstanding tool bit. Available in ten sizes from 3/16 to 1 inch square.

Circle 602 on Readers' Service Card

#### Skinner Chuck

Chuck utilizing combination of a pinion-gear plate, screw, and wedge to actuate its jaws, developed by the Skinner Chuck Co., New Britain, Conn. This chuck is designed to combine all the desirable features of hand and power chucks. It is claimed to be accurate within 0.001-inch total indicator reading, and to have repeatability without adjustment within 0.0005-inch total indicator reading, unequalled gripping power, and no size limitations. In operation, the pinion, which can



be turned either by hand or by a power wrench, engages the gear plate, causing the screw to move the wedge. The action of the screw on the wedge controls the chuck jaws. The pressure of the wedge on the jaws holds the work with tremendous force. A shear pin keeps the chuck from being tightened beyond its capacity and protects the operator. An eccentric fail-safe mechanism locks rotation

#### **300 HOUSINGS PER HOUR**

## produced on Greenlee machine—with assist from VICKERS, hydraulics

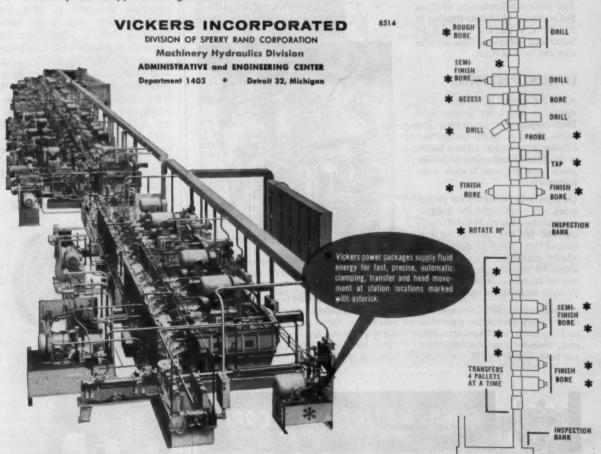
Here's a Greenlee transfer machine that produces 300 steering gear housings per hour while performing a total of 114 close tolerance machining operations. This outstanding performance record is achieved because the machine combines advanced design ideas with the best available components.

Self-contained Vickers hydraulic power packages provide controlled power for clamping the pallet-mounted workpieces in precise position at each work station, driving transfer mechanisms and for movement of certain machine heads. These power packages are designed to JIC (Joint Industry Conference) standards which means easy maintenance and minimum downtime to you.

Vickers offers you power packages, either standard or custom engineered that provide an almost unlimited number of choices to meet your specific technical requirements. You can choose from the broadest product line in the industry any combination of controls for use with single, double, two-pressure or two-stage pumps (the latter for pressures to 2000 psi), and for variable and constant delivery pumps to 5000 psi. Your choice of components will be packaged with the size or shape reservoir best suited for your job.

Whether the Vickers power package you choose is standard or custom engineered, you save money and time because it comes ready-to-go—designed and assembled to the highest standard of quality by hydraulic specialists.

Get more data by writing today for Bulletin 5001C or by consulting your nearby Vickers application engineer.



CONTROL

MILL

SE ROTATE SO

MILL

INSPECTION S

DRILL

283

INSPECTION

## Microhoning\* Transmission Gears Simplifies & Improves Production

Improved product performance and simplified processing — two major factors that are accelerating the swing to Microhoning. Typical of this swing is a major manufacturer of regular and compact automobiles. In the processing of gears for automatic transmissions, this company selected Microhoning for a number of flat surfaces, bores and O.D. of a housing hub—HERE'S WHY!

#### SIMPLIFIES PROCESSING

Double surface Microflat machines simultaneously Microhone both flat surfaces of pinion and sun gears—first, to obtain proper thickness and parallelism on soft gear blanks. This simplifies subsequent operations (boring, hobbing, chamferring, etc.) by eliminating former orienting of gears to a single finished surface.

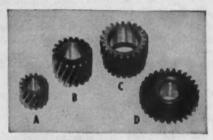
The second Microhoning of these flat surfaces, after heat-treating to 59 R "C", quickly removes all burrs and generates final accuracies and surface finish.

#### EFFICIENT PRODUCTION

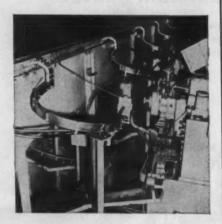
After the second flat-Microhoning operation, gears are conveyed to Microhoners for processing the bores. Typical, of the production efficiency realized on all gear bores, is the bore-Microhoning of pinion gears (nine are used in each large transmission).

On eight Microhoners these pinion gears are automatically loaded, positioned, bores Microhoned, checked for size, segregated and ejected (see photo to right). This wholly automatic sequence takes about 18 seconds per gear. Only one set up man is required to keep all eight machines in operation.

An average of .002" stock is removed from each bore; generated surface finish is 10 microinches, rms; roundness and straightness are held within .0001" tolerance;



"A"-pinion gear for large transmission
"B", "C" & "D"-pinion and sun gears
for compact car transmission



diameter within .0003". Comparable results are obtained on other gear bores (see facing page).

This efficient precision production assures consistent results. Also, reliable precision on component parts is a prime answer to "Why" better performing automatic transmissions are obtained.

\*Registered U.S. Pat. Off.



MICROMATIC HONE CORP.

if the shear pin should break and a self-locking mechanism prevents the chuck from opening under any load or centrifugal force conditions. The center hole permits barstock chucking. Chip plates plus top and bottom seals keeps the operating mechanism free of foreign matter. Made in thirteen sizes ranging from 10 to 60 inches and in optional jaw types.

Circle 603 on Readers' Service Card

#### **Kenco OBI Presses**

One of a complete series of 18ton open-back-inclinable presses brought out by the Kenco Mfg. Co., Los Angeles, Calif. Standard models in 18-ton capacities will include "electro-safe," standard, slow-speed, variable-speed, and deep-throat types. Shut-height combinations are offered for a wide range of die requirements, and optional accessories feature higher speed with greater safety. An optional extra, the Kenco "Cycle-Safe" clutch, employs roller construction designed to offer the greatest safety under severe service. This clutch is said to provide extreme precision and maximum insurance against double tripping. It is claimed to be virtually indestructable. Substantially greater frame strength is achieved by balanced ribbing and controlled cooling of the casting, thus removing internal stresses, reducing deflection under load, and increasing die life. Crankshafts are of one-piece, heat-treated alloy, precision-ground construction.

Circle 604 on Readers' Service Card





### A-L-D Automatic Fluid Dispenser

Multiple-purpose automatic lubricant dispenser designed to dispense oils, light grease, liquid soaps, tap lubricants, glycerin, and many other liquids brought out by the Logansport Machine Co., Inc., Logansport, Ind. This device eliminates oil cans and daubers, provides positive fluid ejection, and assures accurate volume adjustment. The unit may be purchased separately or with reservoir and actuating switch.

Circle 605 on Readers' Service Card



### Woodworth "Ball-Lok" **Power Chuck**

"Ball-Lok" power chuck with balljoint actuation developed by N. A. Woodworth Co., Detroit, Mich. Ball-joint actuation affords pullback action against fixed work stops that is said to result in greater accuracy and rigidity in chucking parts. Up to 5 to 1 linkage ratio generates a tremendous gripping power and the "Ball-Lok" is claimed to guarantee a minimum of friction loss. The entire actuating mechanism is completely lubricated and sealed, eliminating wear due to chips and foreign matter. Jaw segments are reversible, interchangeable, and can be serrated or furnished with in-

### HOW M

## **Microhoning\* Transmission Gears Simplifies & Improves Production**

A major manufacturer of regular and compact cars has selected Microhoning as the most efficient method for securing consistent precision, controlled surface finishes, and simplified processing. Microhoning is used on the flat surfaces and bores of a number of transmission gears plus the O.D. of a housing hub. HERE'S HOW!





Flat-Microhoning small transmission gears-head is swung to left for easy



Bore-Microhoning-both spindles fed simultaneously.

#### FLAT-MICROHONING

Both faces of a variety of transmission gears are simultaneously Microhoned. First, soft gear blanks are flat-Microhoned to secure proper thickness and parallelism within .0003", and a finish of 30 microinches (rms) or better. This simplifies subsequent processing by eliminating formerly required orienting of part to only one finished face. The second flat-Microhoning of faces, after heat-treating to 59 R "C", quickly cleans up all burrs while generating final accuracies and finishes.

### BORE-MICROHONING

The Microhoning of bores for large transmissions is described on facing page. The smaller transmission uses pinion and sun gears having various bore sizes (.697"D. x 3/4"L., .697"D. x 1-3/32"L., 1.030"D. x 7/8"L.). To generate roundness, straightness, size and surface finish, these bores are processed on double-spindle Microhoners equipped with shuttle-type fixturing. Straightness and roundness are held within a .0003" tolerance, diametric size within .0005". All gear bores are processed in an average 26-second cycle that includes loading, Microhoning and ejection.

### O.D.-MICROHONING

The converter housing hub of the large transmission is also Microhoned. Hub O.D. is 1.936", length is about 2", and it has a blind end with 1/4" relief. Two progressive Microhoning operations remove a total of about .004" stock to generate a surface finish of 15 microinches in a cycle time of 45 seconds per part. Special Microhoning technique generates circumferential lay on hub O.D. to provide compatibility between it and oil seal rotation. This increases seal life and effectiveness.

\*Registered U.S. Pat. Off.



MICROMATIC HONE CORP.

## ALL

The cost of ALLEN Hex-Socket Cap Screws is only a minor fraction of your assembly costs... be sure you're getting the timesaving, cost-saving advantages of genuine Allens!

Ever since Allen first produced the hex socket head screw nearly fifty years ago, specifying genuine Allens (made by Allen of Hartford) has been a sure way to guarantee dependable threaded fastening.

Only genuine Allens have Leader Points that make starting easier, and greatly minimize danger of cross threading. Genuine Allens are "pressurformd" to preserve the long fibers uncut throughout the length of the screw, giving stronger sockets for greater tightening torque.

Write for samples and engineering data. See how *genuine* Allens will make your product better.



Allen's new 1960 Series Socket Head Cap Screws give up to 2½ times more load carrying capacity, without indentation. Head diameter of sizes from ½" up is now uniformly 1½ times the body



Head diameter of sizes from ½" up is now uniformly 1½ times the body diameter—providing more under-the-head bearing surface, and a proportionate increase in clamping force. Write for new Bulletin G-25, with full specifications.

Stocked and sold by leading Industrial Distributors everywhere



ALLEN MANUFACTURING COMPANY

HARTFORD 1, CONNECTICUT, U.S.A.

serts. Available for both external and internal application in standard 10-, 12-, 15-, and 18-inch sizes. Special sizes are available on request.

Circle 606 on Readers' Service Card



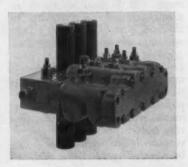
### **Deltronic Plug-Gage Sets**

Precision lapping to approximately 1-micro-inch finish, and cold stabilization during heat-treating, are new features of these all-purpose "tenth" plug-gage sets announced by Deltronic, Costa Mesa, Calif. These gages range in size from 0.120 to 1 inch in diameter. Sizes from 3/64 to 3/32 inch are superfinished. Extremely close tolerance, coupled with 0.0001-inch stepstwelve steps up and twelve steps down from nominal size in each set-provides precision inspection gages at a cost comparable to work gages.

Circle 607 on Readers' Service Card

### Electrically Operated Hydraulic Valve

Multiple-spool hydraulic control valve announced by Double A Products Co. (a subsidiary of Brown & Sharpe Mfg. Co.), Manchester, Mich. This valve is controlled electrically by oil-immersed, dirt-proof, direct-current





## DEPENDABLE ... predictable response to heat treatment every time



Send for Bulletin 102— "Helpful Heat-Treating Hints."

The full uniformity within each bar of Desegatized FM die steel and the consistent uniformity from lot to lot simplifies the heat treatment of your die components. Predictable hardnesses are readily attainable . . . distortion and size change are minimized . . . danger of cracking is lessened!

In free machining FM die steels, full uniformity is achieved through Latrobe's unique Desegatized process of manufacture. This process guarantees an even distribution of carbide particles, free machining alloy sulphides and other alloying elements . . . factors leading to improved machinability, greater toughness and improved wear resistance in addition to the optimum heat-treating characteristics.

Latrobe's 12% chromium FM die steels are available through district steel service centers near you. Grades include: Olympic FM (Type D-2) for long-run applications; GSN FM (Type D-3) non-deforming die steel; Cobalt Chrome FM (Type D-5) for extra resistance to galling and pickup.

Call your Latrobe representative today!

Manufactured by skilled American Tabor



LATROBE STEEL COMPANY

BRANCH OFFICES and STEEL SERVICE CENTERS: BOSTON • BUFFALO • CHICAGO CLEVELAND • DAYTON • DETROIT • HARTFORD • LOS ANGELES • MIAMI • MILWAUKEE NEW YORK • PHILADELPHIA • PITTSBURGH • SAN LEANDRO • TOLEDO



solenoids (in all standard voltages) or optional alternating-current solenoids that are prewired to plug-in type wiring connectors. For service with pressures up to 2000 psi and with a nominal rating of 15 gpm, this valve is now offered in a three-spool size. A two-spool model will soon be available. Important optional features include a built-in, adjustable pres-sure-compensated flow control in the inlet port, to provide constant flows under varying engine speeds. Individual flow controls at each spool are also available. A variety of valve circuits can be furnished to suit specific work requirements. Circle 608 on Readers' Service Card

### Leitz Simplex Toolmaker Microscope

Simplex toolmaker microscope being offered as an addition to the Leitz line by Opto-Metric Tools, New York City. It is claimed that this brings the total up to six sizes and eleven different models now available. In the new instrument the tilt of the tube to the helix angle has been dispensed with, in the assumption that it would predominantly be used for coordinate measurements, not thread check-



ing. As an additional feature, a 360-degree rotary stage is provided to permit measurements in polar coordinates. Total range is 2 by 2 inches with direct micrometer readings in 0.0001 inch.

Circle 609 on Readers' Service Card (This section continued on page 290)

## CONVENTIONAL TWIST DRILL frequently produces long, stringy, unmanageable END "LO-TORK" CHIPS CURL INTO SMALL PIECES AS THEY "LO-TORK" CHIP

EVER!

a chip breaking
drill that actually
improves cutting action
lengthens tool life!

CHICAGO-LATROBE
"LO-TORK"
CHIP BREAKER DRILL





Unretouched photos (above) . . . dramatic proof of Chicago-Latrobe "LO-TORK" Drill's chip breaking effectiveness. Conventional drill at left; "LO-TORK" at right. Same workpiece in each photo.

Study the tips on the two drills shown above and you will understand how "LO-TORK" Chip Breaker Drills work. A new convex shape has been engineered into the flutes. Chips meet this shoulder and are reduced instantly to manageable size without sacrificing any of the efficiency of the tool's point. At the same time the tool produces extra benefits as follows:

- 1. Improved lubrication at drill point.
- 2. Uninterrupted deep hole drilling.
- 3. Faster feeds. 4. Longer tool life.
- 5. New safety for operators.
- 6. Quick, easy regrinds. 7. Less power required.
- 8. Improved plant housekeeping.

"LO-TORK" is a Chicago-Latrobe exclusive, and can be supplied in any regular or special length.

Ask your Distributor
OR CIRCLE NUMBER FOR FREE BOOKLET.
CHICAGOLI ATRORF

428 West Ontario Street, Chicago 10, Illinois



### Vernier Caliper Designed for Easy Reading

Improved vernier caliper to make reading easier, faster, and more accurate, announced by the Scherr-Tumico Co., New York City. This Mauser vernier caliper No. 193 eliminates the troublesome parallax of the standard type vernier by using a flush type vernier scale. Reading thus becomes practically foolproof. Eye strain is at the same time considerably reduced by the lustro-chrome finish on both scale and verniers, the length of which has been doubled for even greater accuracy. Should recalibration and adjustment be needed on either lower or upper vernier, both vernier plates are independently adjustable up to 0.020 inch. A fine cam-lock adjustment is provided

for easy setting at close limits. The caliper is made entirely of stainless steel hardened throughout. Designed for outside, inside, and depth measuring, it has a maximum capacity of 6 1/4 inches with 0.001-inch reading on both lower and upper scales and an over-all length of 9 1/8 inches.

Circle 610 an Readers' Service Cord



### Heavy-Duty Instrument Differentials

One of a line of precision heavyduty instrument differentials available in both precision ball bearing and oil-less bearing types from Pic Design Corporation, East Rockaway, L. I., N. Y. This differential is available from stock in "V7" type units which are balanced with interchangeable endspur clamp rings—a unique design feature, which permits the user to change end gears upon demand. A wide variety of end gears is also available from stock in aluminum and stainless steel, and in pitch ranges from 48 to 120.

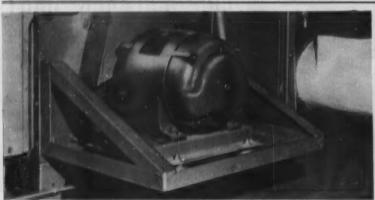
Circle 611 on Readers' Service Cord

### Schrader "Midget" Air Cylinder

"Midget" air cylinder developed to meet industry's demand for small, powerful units by A. Schrader's Son, division of Scovill Mfg. Co., Brooklyn, N. Y. This company



is now producing a series of these cylinders designed to supply maximum power in minimum space. The new double-acting units have 1-inch bores and are suitable for air pressures up to 125 psi. There are six models in the series, each of a different stroke size-1, 2, 3, 6, 9, and 12 inches. They are well suited for a wide range of lightduty and "gang type" air applications, such as operating jigs and fixtures or transfer and specialpurpose machines. The cylinders can be neck, angle-leg, or clevisbolt mounted. They can be adapted to perform any push, pull, or reciprocating motion on parts of power presses, press brakes, clutches and all types of doors, hatches, clamps, and material-handling equipment. They can be actuated by hand, foot, pilot, cam,



### year 'round solid comfort WITH BROOK MOTORS

Thousands of employees can work in air conditioned solid comfort in hundreds of offices, plants and institutions thanks to the quiet, economical, unfailing performance of Brook a.c. Motors—the motors you can install and forget—the better motors that actually cost less. All standard enclosures—I to 600 H.P. The 30 H.P. BROOK open drip proof motor shown is one of many driving air conditioning equipment in the new State Office Bldg., Richmond, Va. Send for literature and name of your dealer.



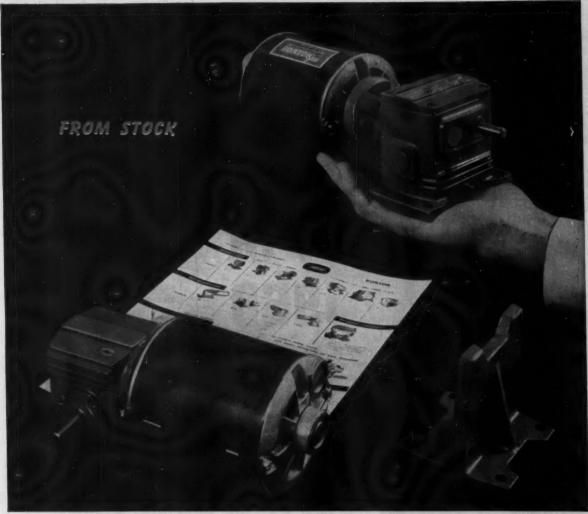
"World's Most Respected Motor"

### BROOK MOTOR CORPORATION

BEQUITE THE STATE OF CANADA, LTD.

BEQUITE AVE., TORONTO, ONTARIO

Warehouses, Factory Representatives, Distributors in Principal Cities.



THE NEW M109 Ratiomotor (foreground) for horizontal right angle drives is furnished with 1/20 hp or .035 hp motor. Output speeds range from 43.8 to 350 RPM. New standard mounting bracket shown

permits easy mounting in many positions. The NEW MW109 (in hand), for horizontal parallel drives, is also furnished with 1/20 hp or .035 hp motor. Output speeds range from 1.9 to 70 RPM.

### **NEW Ratiomotors meet demand for**

### **BOSTON** Gear efficiency in "pint-size" power packages

Now, you can get BOSTON Gear quality and lasting economy in speed reducers for drives as low as .035 hp. Two new units, designed for space-saving, provide a wide range of output speeds.

When you need worm-geared reducers, you'll find any type and ratio you want in

the big line of over 1600 BOSTON Gear 100 Series Reductors and Ratiomotors . . . and you can get it FROM STOCK. Catalog No. 57, with the NEW PRODUCTS Supplement, lists full information. Get your copy. Boston Gear Works, 65 Hayward St., Quincy 71, Mass.

Advt. copyright by Boston Gear Works

NEARBY DISTRIBUTOR







Ask Distributor for NEW PRODUCTS SUPPLEMENT to Catalog No. 57

- STANDARDIZATION PAYS -



When it a vital part, design it to be FORGED



roller-trip, or solenoid devices. Through use of these cylinders, many holding, moving, or positioning steps can be changed from manual to automated operation.

Circle 612 on Readers' Service Card



### "PresSure Kool" Coolant Pump

A positive-displacement pump for machine tool coolant delivery systems has been developed by the Products Division, Associated Engineers, Inc., Springfield, Mass. This "PresSure Kool" pump utilizes a helical-screw rotor. The rotor, turning in a stator, insures positive delivery of coolants or cutting oils at any one or more constant pressures. The vibrationfree, positive-displacement pump delivers clear, nonfoaming coolant without constant manual control of coolant flow. Pump drive starts automatically but can be an integral part of, or separate from, the machine drive. The pump-outlet design makes it possible to operate several delivery lines simultaneously under differing but constant pressures.

Circle 613 on Readers' Service Card

### Setko Self-Tapping Set-Screw

Self-tapping set-screw designed to cut production costs and eliminate problems encountered in tapping most metallic and plastic materials, announced by Set Screw & Mfg.





### focused flux from ceramic magnets mean maximum power

The new Walker Permanent Magnetic Ceramax Rotary Chuck designed especially for lathe as well as grinding applications has one unique advantage over other types of magnetic chucks — it actually prevents magnetization of the machine, the tools and the work — the work piece and tool remain chip free. In addition — powerful permanent Ceramic magnets, providing positive holding with three times the coersive force of ordinary alnico magnets, make possible safe, rugged lathe turning.

Other features:

Variable holding for easy work positioning
 Rotationally balanced
 All steel work surface
 Special "Lock" feature prevents sudden demagnetization while chuck is rotating
 No electrical accessories

• Sizes — Diameters 4" x 12"

### 4 Hi Power Standard Electric Chucks

Walker Hi-Power Standard Electric Chucks are used with all general grinding, and feature heavy cast steel construction, hi-magnetic efficiency, dimensional stability. These famed chucks have long been recognized as the most dependable in electro-magnetic holding.

EE catalog write s

0.5.Walker co., Inc.

ROCKDALE ST. • WORCESTER 6, MASS.
Original Designers and Builders of Magnetic Chucks



at Arvin Industries, too...

## FEDERAL-WARCO

High volume producers of precision metal products, Arvin Industries consistently get highest quality welds with Federal Multi-gun, automatic resistance welders.

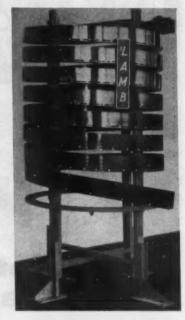
Arvin quality control experts, like those of other leading metal fabricators across the country, know they can rely on Federal resistance welders and Warco mechanical presses to maintain quality and still meet highest production quotas. Precision-engineered to your requirement by:

THE FEDERAL MACHINE AND WELDER COMPANY



Co., Bartlett, Ill. It is claimed that the exclusive design of the cutting edges gives the screw a tendency to actually pull itself into the untapped hole. Metal and plastic chips are gathered into the oversize flutes. The cutting-in action takes place at the lower three threads of the screw. It is possible to use this screw for standard applications and for sizing poorly tapped holes as well as for easy insertion in paint-filled holes.

Circle 614 on Readers' Service Card



Helical Storage and Lowering Unit

Part storage and lowering unit designed and built by Fabri-Tech, a subsidiary of F. Jos. Lamb Co., Detroit, Mich. This unit is said to be finding wide application in automatic work-handling installations for production of such parts as pistons, bearings, blanks, and similar parts with rolling or sliding characteristics. The helical unit is comprised of Lamb Fabri-Flex chuting coiled around and attached to a frame. Part flow through the unit is gravitational and constant. Critical surfaces of finished parts are protected by the inherent rapid deceleration provided by the first turn of the helical path and the braking action set up by the centrifugal force of the part against the outer rail of the track.

Circle 615 on Readers' Service Card (This section continued on page 296)

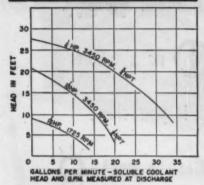
If what you make is round or square or odd shaped If you make it one 1 at a time or by the millions If you want to check its OD or its ID ( or a whole lot of dimensions at once ... and if you want or ring a bell or stop a machine on the basis of tolerances down to thousandths .001 or millionths .00001 SHEFFIELD can recommend the exact type of Air, Electric, Electronic, Visual or Limit gages you need... or a complete automatic gaging or assembly machine or system... with dimensional quality control based on the ultimate standard of gagemaking: INTEGRITY



A subsidiary of The Bendix Corporation

Gages, Measuring Instruments, Automatic Gaging & Assembly Systems • Machine Tools • Contract Mfg.

### FOR MORE **COOLANT PUMP ECONOMY\***



\*Performance Chart

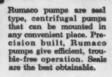


Gusher flange mounted coolant pumps feature a simple design with no seals, no packing or priming necessary. They are designed to mount on the side of the reservoirs with either external or internal discharge. Improped type discharge. Immersed type also available.

Model 5-P



Seal Type



Model 5-S

WRITE FOR FURTHER INFORMATION TODAY



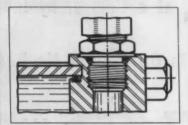
#### ACHINERY CO.

- . COOLANT PUMPS
- MOLTEN METAL PUMPS

1807 Reading Rd. . Cincinnati 2, Ohio

### Straight-Thread Port for **Hydraulic Cylinders**

Straight-thread port now available as standard on Series "H" hydraulic cylinders made by Power Cylinder Division of the Hannifin Co., Des Plaines, Ill., a division of



Parker-Hannifin Corporation. Extensive research has shown that the use of this new straight-thread cylinder port eliminates many of the leakage problems associated with pipe-thread cylinder ports. Other benefits: no distortion due to the wedging action of a pipe-thread connection; elimination of pipe dope; exact positioning of the fitting without overtightening or back-off; immunity to leakage caused by extreme temperature variance or shock conditions; and mechanically rigid connections, since fittings work on the full thread surface.

Circle 616 on Readers' Service Card

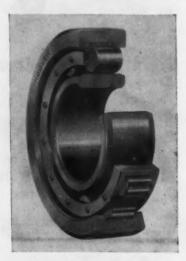
### **Proximity Switch**

Magnetically operated proximity switch designed for use as limit. interlock, counter, or indicator sensor under such unfavorable environments as those created by oil, grit, extreme vibration, dirt, or sludge. It is being introduced by Minneapolis-Honeywell's Micro Switch Division, Freeport, Ill., and



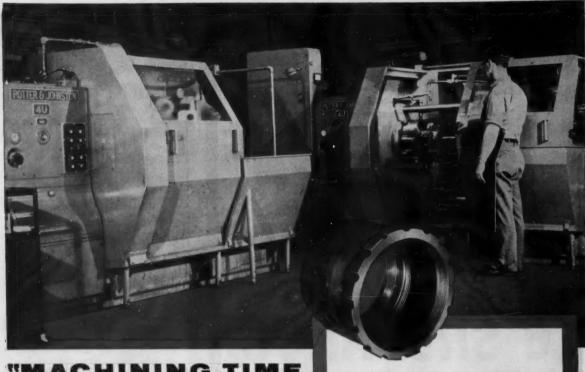
consists of a sensor and a separate transistorized amplifier with plugin relay. The sensor detects magnetic material without physical contact and feeds an electrical output to the remotely located amplifier. The amplifier operates the double-pole, double-throw relay, which is wired to the circuit in the same manner as a conventional limit switch. The two components of the new unit may be located up to 150 feet apart without the use of shielded wire. The new switch can sense products with highly polished surfaces without touching them, thus eliminating the possibility of scratching. In addition, it can detect small items without retarding their flow. Its versatility is demonstrated by the fact that it can be used to sense products ranging from automotive frames to bottle caps.

Circle 617 on Readers' Service Card



### **Hoover Roller Bearing**

Cylindrical roller bearing of new line that features "Super Finish" rollers and raceways announced by Hoover Ball & Bearing Co., Ann Arbor, Mich. The raceways and rollers of the new line are "Super Finished" to obtain exceptionally smooth, mirror-like working surfaces for increased life and performance. The cylindrical roller bearings are designed with crowned rollers that provide exceptional radial load capacity for conventional-size, standardwidth, single-row bearing. Because they are cool-running, high-speed operation under heavy radial loads



### "MACHINING TIME CUT 50-75%

### ...when we re-equipped with Potter & Johnston®Automatics!"

The world's oldest and largest producer of coal mining machinery, Joy Manufacturing Company, of Pittsburgh, Pennsylvania, was looking for a faster, more economical way to machine a variety of components. After a thorough investigation, which included time estimates for machining 12 different components, 2 Potter & Johnston 4-U Automatic Turret Lathes were selected over several competing makes. Among other factors, the P&J Machines were chosen, because their sturdier construction and greater power meant more metal removed faster, because their 6-face turrets and 2 cross slides provided greater multiple tooling capacity, and because fully automatic operation made it possible for 1 man to operate both machines. On-the-job results have amply justified Joy's decision. For example, machining the typical component shown here, previous time of 22.2 minutes has been reduced to 11.6 minutes using only one P&J Automatic and 5.9 minutes using both machines operated by one man!

Potter & Johnston Automatics helped this manufacturer save time and money—and they can do the same for you! Call the Pratt & Whitney Branch Office in your area and ask one of our Machine Tool Specialists to recommend a production plan for your specific needs. If you prefer, write direct, outlining your requirements. Pratt & Whitney Company, Inc., 12 Charter Oak Boulevard, West Hartford, Connecticut.

#### JOB FACTS:

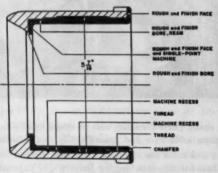
PART: Headlight Bell

MATERIAL: Malleable Iron Casting

REQUIRED: 11 roughing and finishing cuts: boring, reaming, facing, undercutting, grooving, tapping.

THE MACHINES: Two P&J 4-U Automatics operated by one man.

THE RESULTS: An accurately machined part completed every 5.9 minutes.



BLACK AREAS INDICATE METAL REMOVED

### POTTER & JOHNSTON AUTOMATICS

MANUFACTURED BY

### PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS . GAGES . CUTTING TOOLS



machine all these small parts from

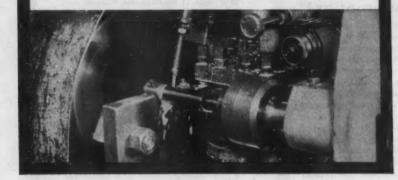
Bearings
Blanks
Bushings
Cams
Clutch Plates
Collets
Cylinders
Dies
Discs
Gauges
Gears
Jigs
Liners

**Pinions** 

**Pistons** 

Plug Laps
Pulleys
Pump Parts
Quills
Rings
Rolls-Rollers
Seals
Sheaves
Sleeves
Spindles
Sprockets
Trunnions
Valve Guides
Valve Parts
Washers

6'SHENANGO IRON BARS



Now, many parts formerly cast to shape can be machined at lower cost from Shenango solid bars and centrifugally cast tubular bars.

Bars and tubes are available centerless ground for automatic screw machines or as cast for turret or engine lathe work. Expensive patterns are eliminated. Uniformity is guaranteed. Inventory is reduced. Production output is increased.

Write on your letterhead for a machining sample of Mechanite Metal, Ni-Resist or Ductile Iron. Centrifugally Cast Products Division, The Shenango Furnace Company, Dover, Ohio.

CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES . MANGANESE AND ALLMINUM BRONZES MONEL METAL . NI-RESIST . MEEHANITE METAL . ALLOY IRONS . DUCTILE IRON

is possible. Retainers are machined from solid bronze for strength and accurate roller guidance. These roller bearings are offered in three widely used series in a complete range of sizes. Each series provides the option of five variations—straight inner and outer races, single-flanged inner and outer races, and single-flanged inner races with stabilizing ring.

Circle 618 on Readers' Service Card



### Atrax Stub Router

Single-flute type solid-carbide stub router brought out by Atrax Co., Newington, Conn. The short length of this precision-ground Series 1546 stub router assures great rigidity. It has a single, straight flute and a straight shank. It is single-end and right-hand cutting. Made of solid carbide throughout, its diameter is held to size within a tolerance of plus 0.000 and minus 0.003 inch. The single-flute stub design is especially recommended for routing materials that are difficult to machine, such as glass, epoxy materials, Fiberglas, phenolics, bakelite, and other abrasive materials, including the routing of printed circuit boards.

Circle 619 on Readers' Service Card

### Variable Vane Pump

Vane type variable-volume hydraulic pump with delivery capacity of 6 gpm added to line made by Vickers Incorporated, Detroit, Mich., division of Sperry Rand Corporation. While specifi-





### He's Watching a Band Sawing Miracle

This band saw operator at the Bell & Gossett Company plant in Morton Grove, Illinois, is watching "Controlled Accuracy"... accuracy, being held to within a few thousandths of being perfectly straight, and he can actually see the band blade being guided in the saw cut to produce this accuracy! No further machining is required before the pipe is welded into an assembly for a Bell & Gossett Heat Exchanger Unit.

Band sawing accuracy like this is nothing short of miraculous—especially when it can be done on a high production basis, as Bell & Gossett is doing. And when the same tolerances can be held on cut-off pieces from 2" to 18" in diameter, this Marvel #81 Band Saw Machine can be truly called a precision machine tool.

The secret of this amazing sawing accuracy is in the Marvel "Sure-Line" Automatic Accuracy Control—a simple and extremely effective

electro-mechanical servo-mechanism that continuously senses and automatically corrects any tendency of a band blade to drift to either side of a desired line of cut. The "SURE-LINE" unit literally "steers" the blade to make a straight cut. This permits the use of heavier feed pressures and, when desirable, higher blade speeds, to do the work faster, without sacrifice of accuracy. Incorporated in the new Marvel #81 Series High Speed Heavy Duty Hydraulic Band Saws, the "SURE-LINE" permits full utilization of all the advantages of high speed steel band saw blades—while extending their usable blade life as much as 50%.

Before you buy any band saw machine, get complete details on MARVEL #81 Series Single Cut, or Automatic Shuttle Type Bar Feed Production Band Saws—the machines DESIGNED AND BUILT TO REDUCE SAWING COSTS. Write for catalog today.



ARMSTRONG-BLUM MANUFACTURING CO. 5700 West Bloomingdale Avenue • Chicago 39, Illinois



for man who's HA

Columbus Die-Tool can help!

Many leading companies all over the United States are now availing themselves of our creative engineering staff, modern plant and equipment, to design and build their special tools, jigs, fixtures and machines. Over 50,000 square feet, filled with precision production equipment, enables us to build fine tools and special purpose machines to your exacting requirements. Increase the efficiency of your operation with special tools that do the job better—faster—more economically . . . designed and made by Columbus Die-Tool.

FREE: New brochure listing complete facilities and equipment. Write today.

## Columbus Die-Tool



AND MACHINE COMPANY

P.O. BOX 750 • COLUMBUS, OHIO SERVING INDUSTRY SINCE 1906

Designers and manufacturers of Jigs • Fixtures • Special Tools • Units for Machine Tools • Builders of Machine Tools Complete cally designed for low-cost machine tool drill feed and automation applications, the unit is adaptable to wide use in circuits that require pump delivery to vary according to system needs while maintaining a pre-selected adjustable pressure. The pump includes an integral pressure compensator that can be set for operation at from 200 to 500 psi. Maximum delivery can be limited by means of a mechanical adjustment. Sharp cutoff characteristics enable the pump to deliver nearly full volume even at low operating pressures. Variable-volume and pressure-compensation features eliminate the necessity for a relief valve and attendant piping.

Circle 620 an Readers' Service Card



Ross Air Valve

High-efficiency, lightweight solenoid valve called the "Pacer" introduced by Ross Operating Valve Co., Detroit, Mich. This air valve is said to have about three times the flow capacity of most conventional solenoid valves of comparable size. Other features include: cycling in excess of 1000 cycles per minute; full 5/32-inch minimum internal orifice (N.C. side) yet requiring only 7 watts of power; short poppet travel; dust- and liquid-tight seal; light weight (28 ounces) with cast-aluminum body; and integral wiring space. It is designed to JIC specifications. Also available as a three-way valve, the Pacer can be manually actuated and is inoperative if the captive cover is removed. Accommodates 1/8-inch and 1/4-inch pipe.

Circle 621 on Readers' Service Card

### INNOCENTI MECHANICAL DIVISION

head office:

offices and factory

MILANO

METALLURGICA E MECCANICA

PER L'INDUSTRIA

Via Pitteri 81 - tel. 23-93 centralino

ROMA

Via Parigi 11 - tel. 487.051

offices abroad:

**NEW YORK** 

INNOCENTI CORPORATION - 43 West 61 Street - N.Y. 23 - tel. Columbus 6-7795

INNOCENTI - 6, Av. F. Ropsevelt - VIII - tel. Balzac 03-81

INNOCENTI U.K. Representative - Uganda House - 68/59 Trafalgar Square W.C. 2 - tel. Whitehall 2075

CARACAS

INNOCENTI - Edif. Sudameria

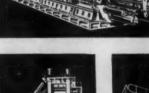
Avenida Urdaneta y Fuerzas Armadas - tel. 848.461

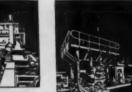




### Steel work equipments

- Large electrical furnaces for steel making
  - Manipulators for Martin furnaces
    - Forging presses
- Continuous casting of steel and non-ferrous materials
  - Ingot hot peeling machines &
  - Complete rolling mills for blooms and slabs
  - Rolling mills for billets, rails, bars and shapes
  - Sendzimir hot planetary mills for strips
- Medium and small rolling mills for plates, strips, shapes,
  - - bars, round bars and wire rod
- Sendzimir cold rolling mills for strips
- Continuous mills for cold rolling of large strips and plates
  - Pickling and shearing lines
- Rolling mills for seamless steel tubes
- Plants for production of large diameter butt welded tubes
  - Auxiliary equipments for tube plants
    - Complete steel works











Large, high-powered milling and boring machines Presses for hot and cold drawing.





## MOUNTS OF THE INDUSTRY

### California and Washington

BAY STATE ABRASIVE PRODUCTS Co., Westboro, Mass., has purchased the Felker Mfg. Co., Torrance, Calif. The Felker Co. will be operated as a wholly owned subsidiary of Bay State under the direction of vice-president Elden L. Auker. Lester F. Kusmick will be retained as manufacturing manager and Fred K. Ryan as sales manager.

IDEN F. RICHARDSON has been appointed a vice-president of HUGHES AIRCRAFT Co., Culver City, Calif. Mr. Richardson will continue to serve as manager of the company's commercial products activities, a position to which he was named in October of 1959.



Lawrence M. Weitzel, president, Mechanical Specialties Co.

MECHANICAL SPECIALTIES Co., Los Angeles, Calif., announces that LAWRENCE M. WEITZEL has been elected president. He succeeds CARL T. WEITZEL, who died in March. Mr. Weitzel started with the company in 1941 as tool-crib attendant and worked in all plant departments. He became vice-president in 1952.

JOSEPH T. RYERSON & SON, INC., Seattle, Wash., announces the following appointments. DWIGHT E. SCHURMAN is named general superintendent, succeeding Chris A. Papadinoff, who becomes general superintendent of the firm's plant in Boston, Mass. Chester C. Warren is appointed manager of work order, industrial plastics, and bearings sales. His former post of manager of the general order department is assumed by Marvin R. Konuper who continues to head the merchandise-inventory department.

### Illinois, Indiana, and Wisconsin

The AMERICAN MACHINE TOOL DISTRIBUTORS' ASSOCIATION will operate an Information and Message Center at the Machine Tool Exposition-1960 to be held in Chicago at the International Amphitheatre September 6-16, it has been announced by R. W. Nissen, chairman of the Association's Exposition Committee. The information center will be located opposite the registration area on the second floor of the Amphitheatre. In addition, five information and message phones will be located throughout the Exposition to give visitors and exhibitors easy access to the variety of services available. Visitors may post or receive telephone or other messages for anyone attending the Exposition.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., announces the following appointments. WILLIAM P. LOEHRER is appointed district sales manager, Chicago plant. Succeding him as manager of alloy and stainless-steel sales, Chicago plant, is G. PHILLIP LATER. BRUCE D. CLAUSONTHUE is appointed manager of the general order division, Chicago. He takes over this post from DONALD E. WOODRUFF who has been transferred to the company's general office, also in Chicago, pending new assignment to be announced later.

ILLINOIS TOOL WORKS, Chicago, Ill., announces that construction of a new plant will begin immediately at Des Plaines, Ill., to house its new CONEX DIVISON for the manufacture of thin-wall plastic containers and other packaging products. It will be

located at 1901 S. Prospect Road, and will be ready for occupancy early in the fall of 1960. WALTER J. SIMONS has been named general manager of Conex.

A. FINEL & Sons Co., Chicago, Ill., announce that ARTHUR CARLSON has been elected vice-president of production. Before being elected to this new position he was assistant production manager under Aubrey Lane, who has retired.

GISHOLT MACHINE Co., Madison, Wis., announces the retirement of HOWARD V. MYERS after nearly twenty-five years with the company. He was in charge of the Chicago sales office. JOHN J. ELLIS has been assigned to the Chicago office as a salesman for that territory.

ROBERT E. STEINMAN has been elected vice-president of GAERTNER SCIENTIFIC CORPORATION, Chicago, Ill.

JOHN R. BARTIZAL has been elected president of the CLEARING DIVISION, U. S. Industries, Inc., Chicago, Ill. Mr. Bartizal returns to Clearing after an absence of about six years. Previously he had been associated with the company for ten years through 1954 as a director and executive vice-president.

(This section continued on page 304)



John R. Bartizal, president, Clearing Division, U. S. Industries, Inc.

## Cincinnati Hydroform

makes savings galore for Oneida Ltd.

After changing from conventional deep drawing to Hydroforming to produce the water pitcher body shown below, Oneida Ltd., Silversmiths, made the following cost comparison:

Tooling costs
Set-up costs
Operations

CONVENTIONAL \$3280.00

5 set-ups: \$9.55

3 draws

1 drop form

1 re-draw

1 spin

4 washes

pleses \$11.49

MYDROFORM S600.00

501-up: \$1.65

2 anneal and pickle

Water pitcher body produced by Oneida Ltd. on a Cincinnati 12" Hydroform in one draw. The part was drawn from a 12" dia. blank of .032" coil copper to a depth of 61%".

Max. ID is 4%".

Comment (III)



Cincinnati 12" Hydroform. Also made in 8", 19", 23", 26" and 32" sizes.

These figures speak for themselves. In addition, as Hydroforming produces the part with an unmarred surface finish, and with less thin-out than is possible by conventional methods, additional savings were made in buffing and finishing costs.

If you do deep drawing, or can convert a portion of your component part production to deep drawn shapes, you can receive the same benefits from Hydroforming now enjoyed by Oneida Ltd. Let a Meta-Dynamics Division field engineer give you details.

Hydroform

META-DYNAMICS DIVISION
Machines for Metal Forming and Heat Traction

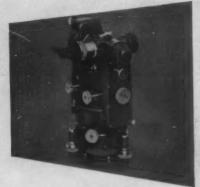
THE CINCINNATI MILLING MACHINE CO. Cincinnati 9, Ohio, U.S.A.

CINCISNATI

to set up and align missile platforms nuclear equipment heavy precision machinery . . .

## MICROPTIC

auto-collimating



reads horizontal and vertical angles direct to 1 second of arc . . .

Convenient, portable, accurate, the Microptic Theodolite is an exact survey-type instrument with horizontal and vertical rotation for checking planes and measuring angles. It is the universal optical tooling instrument for setting up machine tools, radar antennas, atomic reactors, missile and ground support.



GISHOLT MACHINE Co., Madison, Wis., announces the appointment of Paul. H. GOTSTEIN as direct sales representative for the Atlanta, Ga., territory. His appointment was made to fill the vacancy resulting from the termination of the sales agency agreement between the R. O. Deaderick Co. (of Atlanta) and Gisholt. In addition, he will assist the regular dealer agencies in Alabama, Florida, Georgia, and North and South Carolina.

GISHOLT MACHINE Co., Madison, Wis., announces that HARVEY A. WADDELL was elected as its vice-president. He will continue to serve as company treasurer and as a member of the board of directors in addition to his new duties. Mr. Waddell has served in many capacities since joining Gisholt Machine Co. in 1926. Robert H. Bruce was appointed vice-president in charge of sales. Mr. Bruce has been with Gisholt since 1934.



Eugene Makie, vice-president in charge of manufacturing, National Automatic Tool Co.

NATIONAL AUTOMATIC TOOL Co., Richmond, Ind., announces the appointment of EUGENE MAKIE to the position of vice-president in charge of manufacturing. Mr. Makie replaces A. B. McCrea, who has been appointed to the new position of vice-president in charge of finance.

### Michigan

MICHICAN TOOL Co., Detroit, Mich., announces that a new division providing complete facilities for production of highest quality spur, helical, and bevel gears and splines for use in prototypes and in developmental quantities has been formed. The new "Enterprise Division" is the result of combining a number of

previous facilities with newly acquired facilities of the former Enterprise Gear & Tool Corporation. Sales engineering and order headquarters are at the company's main plant and offices at 7171 E. McNichols Road, Detroit.

AMERICAN SOCIETY OF TOOL & MANUFACTURING ENGINEERS, Detroit, Mich., has elected H. DALE LONG, president and chairman of the board, Scully Jones & Co., Chicago, Ill., president of the organization. Mr. Long has been with Scully Jones since 1940. He has been active in ASTME since 1943, holding various offices in the Chicago chapter and the national organization. He was first vice-president in 1959-60. Mr. Long will succeed Wayne Ewing, president, Arrowsmith Tool & Die Co., Los Angeles, Calif., as president for 1960-61.

Ex-Cell-O Corporation, Detroit, Mich., has arranged to purchase the sine plate business of Omer E. Robbins Co. Production and sale of these sine plates are to be handled at Ex-Cell-O's Greenville, Ohio, plant under the Magna-Sine trade name. Russell P. Scholl, sales manager of Bryant Gage products at Greenville, will be in charge of Magna-Sine sales.

MERRILL A. HAYDEN, general manager of the MACHINERY HYDRAU-LICS DIVISION, Vickers Incorporated, was elected a vice-president of the company. Mr. Hayden became general manager of the Machinery Hydraulics Division when it was formed in 1957. For ten years preceding that appointment he was with the Waterbury Tool Division of Vickers, serving successively as general sales manager, assistant general manager, and general manager.

(This section continued on page 306)



Merrill A. Hayden, vice-president, Vickers Incorporated

## HEAVY DUTY HEAVY DUTY HEAVY DUTY ar Box—totally enclose housing—60 feeds, 60 thread changes Wide Carriage — 146 sq. in. of bearing surface Double-Wall One-Piece Cast Apron







## NeBEL HEAVY DUTY LATHES

entirely new...
proven design...

Here are just a few of the many proven design features that help extend Nebel economies even further in the heavy duty field. Write for new, fully descriptive bulletins:

- Heavy Duty Extension Bed Gap Lathe Model HXB 26/45 (Bulletin 211)
- Heavy Duty Model 2013 (Bulletin 212)
- Heavy Duty Model 2516 (Bulletin 213)
- Standard Duty Model 2516-20 (Bulletin 214)





RICHARD A. GREEN has been appointed to the post of vice-president and general manager of the PIONEER INDUSTRIAL ENGINEERING DIVISION OF Pioneer Engineering & Mfg. Co., Detroit, Mich. He was also elected to the board of directors.

SNYDER CORPORATION, Detroit, Mich., announces the appointment of WILLIAM C. GOECKEL as director of sales and ELWOOD M. KEIFER as assistant to the director of sales. Mr. Goeckel will be concerned with all sales of Snyder special machine tools and automated machinery in the United States and foreign countries. He succeeds GEORGE WHITEHOUSE, vice-president of sales, who has retired.

SNYDER CORPORATION, Detroit, Mich., has announced the appointment of JOHN J. MACDONALD as service manager. In his new position, Mr. MacDonald succeeds Charles J. Kraft, former service manager, who has been promoted to Snyder machine-assembly supervisor.

FABRI-TECH, a subsidiary of F. Jos. Lamb Co., Detroit, Mich., announces the promotion of ANDREW J. WATTKINS to chief engineer.

WILLIAM A. CASE has joined the Detroit sales office of PARKER-HANNIFIN CORPORATION, Cleveland, Ohio.

JOHN P. VEDERKO has been appointed vice-president and general manager of DOUGLAS TOOL Co., Detroit, Mich. Mr. Vederko joined Douglas in 1939.

WILLIAM L. LUKENS has been elected to the position of vice-president and assistant to the president of the NATIONAL TWIST DRILL &



William L. Lukens, vice-president and assistant to the president, National Twist Drill & Tool Co.

Tool. Co., Rochester, Mich. Mr. Lukens has been with the firm twenty-four years since first joining the Philadelphia sales office.

### **New England**

New Britain Machine Co., New Britain, Conn., has announced the election of Robert T. Frisbie, Jr., as executive vice-president. Three other changes in the sales organization of the company's New Britain-Gridley Machine Division were also announced. Frank H. Hastings, formerly in charge of the Cincinnati office, has been appointed sales manager for the Division. Stanley M. Brown, formerly sales engineer in the Cleveland office, replaces Mr. Hastings as head of the Cincinnati office. Paul. E. Kennedy has been assigned to the Cleveland territory.

JAMES W. HOPPER has been named assistant to the president of PRATT & WHITNEY CO. INC., West Hartford, Conn. Mr. Hopper joined Pratt & Whitney in 1951 as a gage sales engineer. In 1959, he was made Washington representative, dealing with government business for Pratt & Whitney. He will still represent company interests in Washington.

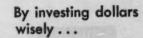
JEAN A. CHABOT has been named field engineer for DENISON ENCINEERING DIVISION, American Brake Shoe Co., Columbus, Ohio. Mr. Chabot is located at 148 E. Center St. Manchester, Conn., for the sale of hydraulic pumps, motors, valves, and controls in the states of Connecticut, Maine, Massachusetts, New Hampshire, upper New York, Rhode Island, and Vermont.

SKINNER CHUCK Co., New Britain, Conn., has announced its acquisition of the Horton chuck line from the Geometric-Horton Division, United-Greenfield Corporation, New Haven, Conn. Horton chucks are presently manufactured in the Geometric-Horton plant in New Haven.

ROBERT F. Hooks has been appointed sales engineer for the CAPE-WELL MFG. Co., Hartford, Conn., for its complete line of metalworking products in Chicago and the surrounding area, including parts of Indiana, Michigan, and Wisconsin.

EDWARD E. KIRKHAM, chief development engineer at Pratt & Whitnery Co., Inc., West Hartford, Conn., since 1958, has been named chief engineer of the machinery engineering department.

AMERICAN DRILL BUSHING Co., Los Angeles, Calif., has appointed



and meshing Monarch
Air-Gage Tracer Dyna-Shift
Lathes into the production
line...

this quality gear maker

## **Cuts Turning Costs over 50%**





### Let Western Gear people tell you how their investment is paying off—quickly!

(The following statements were all made voluntarily by shop men of Western Gear Corporation's Lynwood Works, Lynwood, California.)

- A. "We combine know-how with the finest equipment to machine 'impossible' tolerances in production line quantities. Standard machinery just will not do the job.
  - "On one job the metal involved was nitrolloy and our standard lathes required 30 minutes. With the MONARCH Dyna-Shift lathe, we produce the same part in only 6 minutes, an 80% reduction of production time."
- B. "In another instance, our standard machine required 75 minutes to machine one part, as compared to only 40 minutes on a MONARCH lathe. Production rejects on standard lathes averaged 7% to 8% on these parts (turned from 4140 steel) ... but we've almost eliminated rejects on the MONARCH lathes, saving as much as 50% on material costs on some parts."
- C. "The manufacture of gears to total composite errors of .0005", and tooth-to-tooth errors of .0002", is an everyday occurrence here. MONARCH lathes have enabled us to maintain these tolerances virtually eliminating rejects and reducing production time per unit by a drastic margin."
- D. "The MONARCH tracer is a production machine capable of turning out different diameter sizes in lots from 100 to 500 pieces and up from the template... yet it does the job without variation, and the only detectable changes occur because of the tool wear."

Isn't it time you investigated the greatest combination in lathes to date—the MONARCH Preselector Dyna-Shift with Air-Gage Tracer? Write for our new booklet No. 2609. It's loaded with many examples of Air-Gage Tracer savings.

The Monarch Machine Tool Company, Sidney, Ohio



For
those
who require
precise
measurements



THE Van Keuren CO.

Since 1929

178 Waltham Street, Watertown 72, Mass.

PRECISION MEASURING TOOLS
... rated the world's most accurate

Plug Gages - Measuring Wires - Optical Flats and Light Wave Equipment - Gage Blocks - Precision Lapping Service and Parts

JOHN S. RICHARD, JR., of Windsor, Conn., eastern manager for the company.



William C. Heard, vice-president, Capewell Mfg. Co.

WILLIAM C. HEARD has been elected to the post of vice-president, sales, for CAPEWELL MFG. Co., Hartford, Conn. Mr. Heard will be responsible for the over-all sales promotion and planning for Capewell's complete line of industrial supplies. In addition, he will continue to direct Capewell's national sales engineering staff.

Van Norman Industries, Inc., New Bedford, Mass., has announced that required formalities have been completed effecting the merger of the American Pulley Co., including its Hubbard Spool Division, into Van Norman. The company also announces that Charles B. Eisenhauer has been named vice-president of the Electronics Division of the parent company. Mr. Eisenhauer will also retain his title of general manager responsible for administration and operation of the Electronics Division plant.

BOSTON GEAR WORKS, Quincy, Mass., a division of the Murray Co. of Texas, Inc., has announced three top-management staff promotions. EDGAR V. RANKIN, former general manager, has been appointed vice-president; WILLIAM R. KUNKEL has been advanced from assistant general manager to general manager; and ROBERT G. EMERSON, JR., has been named assistant general manager. Mr. Emerson has also been promoted from assistant secretary to secretary of the Murray Co. of Texas, Inc.

ELECTRONICS AND INSTRUMENTA-TATION DIVISION, Baldwin-Lima-

### Milford Rivet & Machine Company reports ...

## Precision Parts Ground 20 TIMES FASTER when put on the No. 18 Blanchard

"408 precision washers, in one chuck load, now surface ground in same time as 20 by former method... substantial savings on all other Blanchard-ground jobs... finished work quality outstanding... former sub-contracted jobs now done at less cost in our own shop... operator fatigue practically eliminated... maintenance is very low."

Are you missing opportunities like these by not using Blanchards on your surface grinding jobs? Write for your copy of "Work Done on the Blanchard"

THE BLANCHARD MACHINE COMPANY 64 State Street, Cambridge 39, Mass., U. S. A.



W-1177

NEW .: . IMPROVED . . . model 15A



for high-profit, low-cost punching, notching and nibbling ... for prototype, short and medium production runs

FEATURING the new Strippit Electro-Hydramatic Head — simplified design . . . minimum number of parts . . . needs no pressurized air. Makes the 15A easier to install, simpler to maintain, more economical to operate.



#### punches

any round or shaped hole up to 31/2" diameter in sheet material - up to 1/4" mild steel.

90° corners - rectangular, radii, vee and special shape edge notches up to 1/8" capacity in mild steel.

#### nibbles

straight line or contour shearing up to 38" diameter circle, at 165 strokes per minute, 1/8" mild steel.

### accurate, quick-set gauging

a unique, multiple-stop system for exact work positioning to any layout specifications - in seconds.

### guick-change punches and dies

from one size to another in less than 20 seconds - within easy reach in labeled, built-in file drawers.

to a high speed production punching unit with the Strippit Duplicator and the Dupl-O-Scope or Microbars to punch Duplicator templates.

### WRITE TODAY

for new Catalog 15A and demonstration at your own plant of the capabilities of this high-profit fabrication system.



WALES

Akron, New York 203 Buell Road

In Canada: Strippit Tool & Machine Company, Brampton, Ontario

Hamilton Corporation, Waltham, Mass., has transferred its testing machine product line to the WIEDE-MANN MACHINE Co. This transfer covers the physical testing machine business only and does not include Baldwin SR-4 strain gages, transducers, and associated instrumentation. These products will continue to be marketed and manufactured on an expanded basis by the Electronics and Instrumentation Division.

HEALD MACHINE Co., Worcester, Mass., has elected LAWRENCE H. COUSINEAU president of the company. Mr. Cousineau has been associated with Heald for the past fourteen years. HARTWELL G. HOWE was appointed vice-president and general manager, succeeding CARL M. BEACH. Mr. Beach is relinquishing his duties for health reasons and will return to Cincinnati Milling Machine Co., Cincinnati, the parent company. Mr. Howe, previously domestic sales manager, has served



Lawrence H. Cousineau, president, Heald Machine Co.



Hartwell G. Howe, vice-president and general manager, Heald Machine Co.



Watch the mail for news about COOLTEX.

## GET BRIGHTER, SMOOTHER GRINDING FINISHES

cooltex, the *new* chemical grinding coolant, gives you better finishes because it keeps the work *cooler*... keeps the wheel from loading. Actually lets you use a *finer* grit! cooltex is transparent, so you can *see* the work — and it keeps machines noticeably cleaner. Your Texaco Lubrication Engineer is mailing cooltex idea postcards now. Watch for yours. Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

Tune In: Texaco Huntley-Brinkley Report, Mon. Through Fri.-NBC-TV

TEXACO

Throughout the United States

Canada • Latin America • West Africa



Identification

## Specify PANNIER STEEL STAMPS for a longer life of CLEANCUT MARKING

## 29,335 hammer blows—and still marking cleanly—Pannier Letter and Number Stamps

Rounded corners for finger comfort linewided haud distributes impact, reduces mushrooming.

Added metal in Pannier filler increases durability. Correct bevel gives clearer impression, longer life. Outside bevel longer than inside for protection of character face.

Hond-style

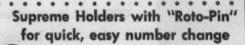
Fullered style

Wood

Made of the finest tool steel and correctly heat treated for best combination of hardness and toughness, Pannier single character stamps can take it! Scientific shaping and accurate engraving insure a long life of good, clear impressions. Available in letters, figures and special symbols, and in light, medium or heavy duty design.

## Extra tough steel forging stamps for hot or cold, heavy duty marking

For stamping names, part or patent numbers, trade marks and similar markings, Pannier forging stamps are made in four styles:—Hand-style, fullered for wire handle and wood handle style with eye parallel or perpendicular to lettering. All are designed and heat treated for clear impressions and long service. All are covered by the Pannier Master Marker guarantee.



Roto-Pin makes this Pannier Master Marker a time saver in number change and makes serial number marking fast and efficient. The hardened anvil at the base of the type slot keeps type in perfect alignment for equal impression. Machined from bar tool stock, the Supreme Holder has a heat treated striking head. Both anvil and striking head are replaceable for longer life of the holder itself. Made in hand or wood handle styles, for hot or cold marking.

Write for literature



easy, half-turnfar Rate-Pin reses any or all of a steel type for shange. A re-

319 PANNIER BUILDING PITTSBURGH 12, PA.
Offices: Los Angeles • Cleveland • Chicago • Philadelphia • Birmingham

PANNIER
MASTER
MARKERS
FOR QUALITY

Heald in various sales and supervisory capacities since 1939. GLENN C. Moore, export sales manager, assumes Mr. Howe's duties as domestic sales manager. CHARLES H. MUNSEY, formerly general manager of Heald Ltd., Birmingham, England, will take over from Mr. Moore as export sales manager. He has been with Heald twenty-four years.

Frank D. Clark, a vice-president of the Van Keuren Co., Waltham, Mass., has been appointed director of the newly created Thread Gage and Instrument Division. Mr. Clark has been with the company for over twenty years, and recently spent nine weeks in England making an intensive study of thread-gage production and manufacturing.

VAN NORMAN INDUSTRIES, INC., New Bedford, Mass., announces that WILLIAM J. MERICKA has been elected chairman of the board. He succeeds DONALD P. HESS, who has retired.

JOSEPH T. RYERSON & SON, INC., Boston, Mass., announces the appointments of Chris A. Papadinoff as general superintendent and Richard C. Miller as credit-office manager for the plant.

ROBERT O. BULLARD has been elected vice-president and general manager of the ELECTRONICS AND INSTRUMENTATION DIVISION, Baldwin-Lima-Hamilton Corporation, Waltham, Mass. Mr. Bullard brings to his new position extensive experience in management, electronics development and manufacture, and metallurgy.

### **New York and New Jersey**

JAMES H. CASSELL, JR., has been elected a vice-president of U. S.



James H. Cassell, Jr., vice-president, U. S. Industries, Inc.

## BUNTING. BEARINGS

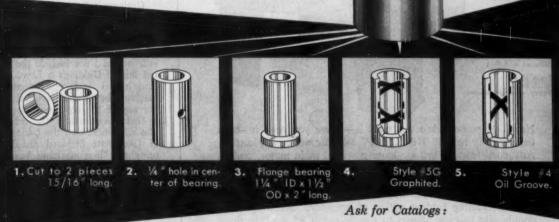
Bunting local machine shop service solves many critical problems

One, or small lots of specially designed bearings, not obtainable from stock, can now be procured immediately through your Bunting Distributor. Fully equipped machine shops in Bunting Branches are at your service for emergency and experimental needs. The wide range of sizes of Bunting stock cast bronze and sintered bronze bearings makes easy the alteration of a stock to a special bearing at low cost. Bunting Cast or Sintered Bronze and Bunting Bearing Aluminum Bars provide the material for special sizes and designs which cannot be made from stock bearings. Your local

Case in Point Showing some common alterations of Bunting Standard Stock Cast Bronze Bearing, No. G-1191. Size 1¼"

10 x 1¾" 00 x 2" long.

Bunting Distributor can arrange for such work.



### THE BUNTING Brass and Bronze Company

TOLEDO 1, OHIO . BRANCHES IN PRINCIPAL CITIES

No. 158 Complete listing of sizes of Bunting Cast Bronz and Sintered Bronze Bearings and Bars, an Bunting Bearing Aluminum Bars. Pocket siz

No. 258 Complete listing of Cast Bronze Electric Motor Bearings for all makes and sizes of electric

No. 46 Technology of Bunting Bearing Aluminum. technical treatise on the composition, machin ing and use of this new bearing metal. Ask you local Bunting Distributor.

BEARINGS, BUSHINGS, BARS AND SPECIAL PARTS OF CAST BRONZE, SINTERED METALS OR ALUMINUM ALLOYS

MACHINERY, June, 1960

For more data circle this page number on card at back of book

INTI

DEIN

G119

313

Industries, Inc., New York City. Mr. Cassell has been director of public relations since joining the organization in 1949. As vice-president, he will continue to direct the company's public, stockholder, community, and press relations.

CHARLES S. BROWN has been appointed to the position of technical advisor at RUSSELL, BURDSALL & WARD BOLT AND NUT Co., Port Chester, N. Y., according to an announcement by FRED E. GRAVES, assistant technical director. Mr.

Brown will assist Mr. Graves in an expanded program of technical service to customers in evaluating assembly practices and applications of threaded fasteners to improve assemblies and reduce costs.

HAROLD B. BERMAN has been placed in charge of technical sales and development of platinized-titanium electrodes produced by ENGELHARD INDUSTRIES, INC., Newark, N. J. The new type of electrodes are being made under an agreement with the British firm, Imperial

Chemical Industries, Ltd. Mr. Berman's duties will include technical assistance to customers in the design, construction, and start-up of facilities utilizing these electrodes.

GEORGE P. HIGGINS has been appointed field engineer in the Norton Co.'s Teterboro, N. J., district office.

#### Ohio

LODGE & SHIPLEY Co., Cincinnati, Ohio, has announced the names of its new representatives in northern and southern California, western Nevada, and Arizona. SEABOARD MA-CHINERY Co., Los Angeles, will distribute the complete Lodge & Shipley lathe line in southern California, while power press brakes, shears, and Floturn machines will be distributed by DAYTON & BAKEWELL Co., also of Los Angeles. In the northern California area, and central and western Nevada, MERRY-WEATHER STRASMANN MACHINERY CORPORATION, San Mateo, Calif., will represent the complete Lodge & Shipley line. For the state of Arizona, the company has appointed the Dow MACHINE TOOL Co., Phoenix, to distribute the entire line of lathes, shears, brakes, and Floturn. Distribution for the Northwest and the state of Utah remains unchanged: STAR MACHINERY Co. for lathes and Floturn and DAWSON MACHINERY Co. for brakes and shears in the Northwest and SALT LAKE HARDWARE Co. for the complete line in Utah.

GIDDINGS & LEWIS MACHINE TOOL Co., Fond du Lac, Wis., has agreed to sell its Cincinnati plant to the CINCINNATI MILLING MACHINE CO. The transaction involved real estate only and did not include the product line of Giddings & Lewis/Bickford radial and upright drilling machines being manufactured there, nor any of the equipment involved in their manufacture. The company also announces that the trade name of Cincinnati Bickford radial and upright drilling machines has been changed to G&L/Bickford. The new name also will be applied to universal radial-drilling machines built by Giddings & Lewis in Kaukauna, Wis. This name change is being made concurrent with the sale of the Cincinnati plant and centralization of drilling-machine manufacture in the company's Wisconsin facilities. Field sales, service, and distribution will remain unchanged. Internal operations will be headquartered in Wisconsin.

(This section continued on page 316)



Now . . . power when you need it—where you need it—with the radically new 30 HP "CHOP" Saw for wet or dry cutting. Advanced features include more powerful main motor, sealed-bearing spindle, timing belt drive, and a new dynamic suspension system that permits light fingertip feed without springs, counterweights or adjustments. Provides straight or variable-speed oscillating feed at option of operator. Screw-operated double vise quickly adjusts to handle up to 8" x 8" sections or solids.

Ty-Sa-Man

Write for FREE BROCHURE
TY-SA-MAN Machine Co., Inc.

1093 White Ave., Knoxville, Tenn.

# AMES DIAL INDICATORS are built by

nonconformists

Ames 100 Series Micrometer Dial Indicator

Some people might be shocked to learn that in this day of automation it takes more than one hundred separate hand operations to build a single Ames micrometer. In many respects we are building and assembling these precision instruments exactly as we did fifty years ago.

Why? Because there are some jobs that can still be done better by a pair of skillful, sensitive hands than by the best automated machinery made. As long as this fact holds true we'll refuse — for your sake — to follow the crowd. For Catalog No. 60 write to: B.C. Ames Co., 27 Ames Street, Waltham 54, Mass. — in Canada, H.C. Burton Co., Ltd., 166 Rebecca St., Hamilton.



Representatives in Principal Cities

B.C. AMES CO.

MANUFACTURERS OF MICROMETER DIAL INDICATORS AND GAUGES ACCU-FLOW AIR .GAGES • TRANSISTORIZED .COMPARATORS









LINCOLN ELECTRIC Co., Cleveland, Ohio, announces that HAROLD D. BALLARD has joined its sales force and will work out of its Milwaukee office contracting accounts in Milwaukee and the southern part of Wisconsin. Mr. Ballard replaces DONALD E. BLy who has been transferred to Appleton, Wis., to cover northern Wisconsin and the upper peninsula of Michigan.

MOTCH & MERRYWEATHER MA-CHINERY Co., Cleveland, Ohio, announced that ALVIN J. JONES and D. M. HALLIER were elected vice-presidents of the company. In his new capacity Mr. Jones will be manager of the Machine Tool Manufacturing Division at the Euclid plant of the company. In a recent reorganization of operating divisions, Mr. Hallier was made manager of the Cutting Tool Manufacturing Division and the Allied Products Division. C. R. Kubik and D. M. Patterson were re-elected vice-presidents at the same meeting. Mr. Kubik is manager of the Machine Tool Distributor Division with head-

quarters in Cleveland and branch offices in Detroit, Cincinnati, and Pittsburgh. Mr. Patterson is manager of the Avey Division in Cincinnati.



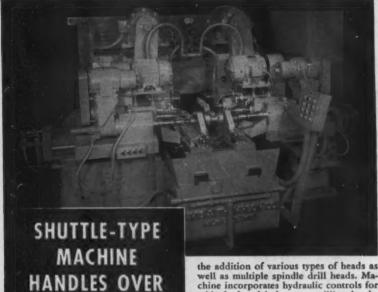
A. S. Burgoyne, vice-president and manager of the Press and Die Supply Division, E. W. Bliss Co.

A. S. BURGOYNE, formerly vicepresident of manufacturing, was appointed to the new position of vice-president and manager of the PRESS and DIE SUPPLY DIVISION, E. W. Bliss Co., Canton, Ohio. His office will continue to be located in the company's general office in Canton, Ohio.

GLOBE-WERNICKE INDUSTRIES, INC., Toledo, Ohio, announces the election of JOHN H. PAUTZ to the position of vice-president of Globe-Wernicke Industries, Inc., Toledo, Ohio, and general manager of its City Machine & Tool Co. Division. Mr. Pautz succeeds Peter Peterson, who retired on May 1.

TIMKEN ROLLER BEARING Co., Canton, Ohio, announces that W. R. TIMKEN has been elected president. Succeeding D. A. Bessmen, who had resigned because of ill health, Mr. Timken assumes his duties immediately. Mr. Timken started with the Timken Roller Bearing Co. in 1935. Elected a director in 1936 and a vice-president in 1941, W. R. Timken has served on the Finance, Executive and Policy Committees of the company before his election in March as acting president of the Timken Roller Bearing Co., the position he held until his election as president.

WILLIAM R. HOUGH, vice-president of engineering for the RELIANCE ELECTRIC & ENGINEERING Co., Cleveland, Ohio, has been assigned



... Mills, Centers, Tap Drills and Taps in #316 Stainless

**40 DIFFERENT** 

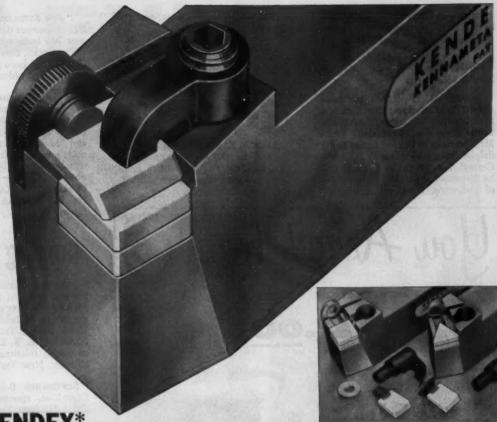
VALVE PARTS

Here's a good example of engineering a semi-standard machine to handle a lot of parts. Although this machine has been adapted to milling, centering, drilling and tapping of valve parts, its basic design lends itself to other operations through the addition of various types of heads as well as multiple spindle drill heads. Machine incorporates hydraulic controls for table feed and index, two milling heads, two hydraulic power heads, each with center drill and tap drill spindle, and two mechanical screw feed tapping heads to accommodate 16, 20 and 24 pitch threads. Capacities range from %" to 4½" diameter, 5" to 23" long. Parts are inner valves for liquid level controls of tough #316 stain-

If you need high production of one part or moderate production of many parts with a minimum capital outlay, it will pay you to call in a D & T production engineer. There is no obligation for this service.

FREE DATA .





## NEW KENDEX\* DIAL-A-BREAKER

### Easily adjustable . . . attached chipbreaker

Quickly, easily . . . set the chipbreaker where you want it, regardless of holder position. The new Kendex Dial-A-Breaker eliminates fumbling and fussing while changing and adjusting chipbreakers and inserts. Chipbreaker is brazed to its adjustment screw. It can't fall out, and the breaker setting may be retained while indexing or changing inserts.

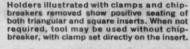
You no longer need a different breaker for every cutting job. Now you just turn the dial and position one chipbreaker for several jobs. Minimum of parts to stock...only two chipbreakers required for 70 styles and sizes of holders.

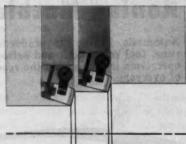
Close ganging of tools presents no adjustment problems with the "Trademark

Kendex Dial-A-Breaker. All changes and adjustments...chipbreaker and insert...can be made from the top of the holder. (The clamp screw is also accessible from the bottom of the tool when mounted in an inverted position on the rear carriage.)

Kendex Dial-A-Breaker Tool Holders have the same basic design and accommodate the same solid Kennametal shims and "throwaway" inserts as used in standard Kendex holders. They are available in positive or negative rake, and with square or triangular inserts.

Get more information. Ask your Kennametal Representative for a demonstration . . . or write Kenna-METAL INC., Latrobe, Pa.





Easily accessible for adjustments. Permits close ganging of tools.



Easy adjustment, regardless of tool position.
Just release the clamp and "diai" the breaker to any position desired.



KENNAMETAL
... Partners in Progress

to a new executive position as vicepresident of research, development, and engineering.

### Pennsylvania and South Carolina

ROBERT H. HAMILTON has been named field engineer for DENISON Engineering Division, American Brake Shoe Co., Columbus, Ohio. Mr. Hamilton is located in the Philadelphia area sales office at 2278 Mt. Carmel Ave., Glenside, Pa., and will be concerned with sales in the states of Delaware, Maryland, southwestern Pennsylvania, Virginia, and the District of Columbia

ALAN G. CATERSON has been appointed technical editor in the newly created Information Services Department of CRUCIBLE STEEL COMPANY or AMERICA, Pittsburgh, Pa. He edited the "Crucible Titanium Review" and has written many articles for publication.

THOMAS E. MURPHY has been appointed by the CARPENTER STEEL Co., Reading, Pa., as assistant manager, tool steel sales, with headquarters in the Reading office.

FIRTH STERLING INC., Pittsburgh, Pa., announces that ROBERT K. WAR-REN has been appointed vice-president of sales, Steel Division. JOHN S. ROLLER has been promoted to assistant to the president.

J. W. VAUGHAN Co., 714 W. Washington, Greenville, S. C., has been appointed sales representative for Vickers "MAGNECLUTCHES" (R) and "MAGNEBRAKES" (R), dry magnetic particle clutches and brakes, it was announced by Vickers Incor-PORATED, Electric Products Division. St. Louis, Mo. Officers of the firm are O. Newell Eastland and Henry B. Tomlin, Jr.

### **Coming Events**

JUNE 5-9-Summer Annual Meeting and Aviation Conference of the American Society of Mechanical Engineers to be held at Statler-Hilton Hotel, Dallas, Tex. For further information: L. S. Dennegar, director of public relations, ASME, 29 W. 39th St., New York 18, N. Y.

SEPTEMBER 6-16-Machine Tool Exposition, sponsored by the National Machine Tool Builders Association, to be held at International Amphitheatre, Chicago, Ill. For more information: Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

SEPTEMBER 6-16-Production Engineering Show, to be held at Navy Pier, Chicago, Ill. For additional information, inquire of Clapp & Poliak, Inc., 341 Madison Ave., New York, N. Y.

SEPTEMBER 7-15-Machinery Show to be held at Chicago Coliseum, Chicago, Ill. For further information, write: A. Byron Perkins & Associates, 2807 Sunset Blvd., Los Angeles 26, Calif.

SEPTEMBER 11-20-German Machine Tool Exhibition to be held in Hanover, Germany, sponsored by Verein Deutscher Werkzeugmaschinenfabriken, Am Hauptbahnhof 6, Frankfort am Main, Germany. Requests for room reservations should be addressed to: Amt für Verkehrsförderung, Friedrichswall 5 (Laveshaus), Hanover, Germany.

**ОСТОВЕК 17-21-Forty-Second Na**tional Metal Exposition and Congress, sponsored by American Society for Metals, to be held at Philadelphia Trade and Convention Cen-

(Continued on page 324)



### SUPERIOR HONE CORPORATION

1623 Eirene Street

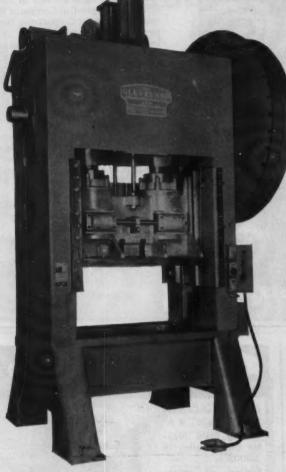
318

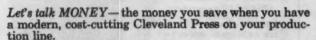
Elkhart, Indiana

## CLEVELAND

AUTOMATION-DESIGNED . COST-CUTTING

## DOUBLE PRESSES





First there is *Production Money*—the money you make more of due to Cleveland's versatile, dependable performance.

Next there is *Downtime Money*—the money you need never worry about with a modern Cleveland Press—ruggedly built, designed for uninterrupted production—the press that pays its way by doing its job day after day.

Then there's *Profit Money*—the money that's extra for you on every production run because your Cleveland Press is precision-built with such secure and precise stroke action that dies last longer, delicate punches can be used with minimum breakage, and your production quality is topgrade, scrap-free.

When you buy a CLEVELAND PRESS, the cost-cutting money you save plus the profit money it earns for you far surpasses the cost of replacing that old press with a modern, quality-built Cleveland Press. That's why it will pay you to look into the advantages Cleveland Presses offer.



Continuous, uninterrupted production is the "profit plus" this new Cleveland Double Crank Press is achieving at the Walker Manufacturing Company in Jackson, Michigan. This multistation, automated Cleveland Press on each stroke pierces, extrudes and forms muffler heads at the rate of 45 strokes per minute (adjustable to 55 s.p.m.). This 150-ton press has a 48" x 36" bed and slide area, 8" stroke of slide with 6" adjustment, electrically controlled air-operated Cleveland (patented) Drum Type Clutch with spring loaded brake, auxiliary air brake on flywheel, and completely enclosed gears running in oil.



Write Today for Double Crank Press Catalog SD2-60

A-EISOA



E. 40th and St. Clair Avenue, Cleveland 14, Ohio

### Built-In Oil System Controls Temperature of Bonding Press Platens



This new hydraulic press, shown partly concealed in the illustration by its oil heating and cooling system. bonds honeycomb sections to skins, and metal to metal, at Grumman Aircraft Engineering Corporation, Beth-page, N. Y. Built by Lodge & Shipley, the press has two upper and two lower platens, with a platen area of 6240 square inches.

The American Hydrotherm Corporation designed the heating and cooling system, which is also piped to a new 10- by 30-foot autoclave, to another platen press, as well as to various dies and fixtures. It contains 3500 gallons of oil, capable of delivering 1,500,000 Btu's per hour. The bulk of the oil (2500 gallons) is stored in an accumulator at 550 degrees F.

The entire bonding cycle is controlled automatically by an electropneumatic system designed by Grumman. Work platens can be heated to 500 degrees F. at a rate of 12 degrees per minute, then cooled at the same rate. They can be maintained at a preset temperature, or progressively raised and

## COLUMBIA

CLARITE (type T1) The "work horse" leader of all **High Speed Steels** 

Product of Skilled American Workmen



## OPTICAL JIG BORER

· Capacity of Coordinate table 6" x 6"

· Setting from master glass scales in .00005"

 Setting of rotary table in 10 seconds Spindle head tilts

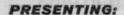
for oblique holes up to 15° from vertical



Request new 8-page catalog 82-47

137-M VARICK STREET, NEW YORK 13, N. Y.

For more data circle Item 320A on Card



# (MORTON

This amazing new machine has movable bridge . . . requires 1/3 less floor space than conventional planer mills. Exclusive tionary easier-to-work table. SEE "THE BRIDGE MILL STORY" Capacity: 2' x 2' to 20' x 20' with Unlimited Length.

Morton Square Rams have extended reach without auxiliary bolt-on supports. Unlimited number of work pieces on sta-

showing the many in-herent advantages of this newest answer to the planer mill. Call your Morton man. He'll be happy to ar-range a showing. Or write direct.

Quality Machinery Since 1880-

MORTON MANUFACTURING COMPANY MUSKEGON HEIGHTS, MICHIGAN

For more data circle Item 321A on Card



END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BUE No. 107 is used to locate high spots
when scraping bearing surfaces. As it does not dry,
it remains in condition on work indefinitely, saving
scraper's time. Intensely blue, smooth paste
spreads thin, transferrs clearly. No grit; nonlinjurious to metal. Uniform. Available in collapsible
tibes of three sizes. Order from your supplier.
Write for free sample tube on company letterhead.

DYKEM CO., 2300R NORTH 11TH \$1., \$7. LOUIS 6, MO.
For more data circle Item 3218 on Card

For more data circle Item 321B on Card



For more data circle Item 321C on Card

# GEARS

Designed and Manufactured to meet

YOUR

**Production Requirements** 

**Custom Gears Exclusively** 

GEAR CORPORATION SYRACUSE 1, N. Y.

For more data circle Item 321D on Card

dropped to any temperature curve within the limits of the system, through a pneumatic cam programming control. Bolster platens, backing up the work platens, maintain a mean temperature on the press structure and prevent the work platens from warping.

Hydraulic ram pressure of the press can be regulated within a range of 0 to 2500 psi, the equivalent of 0 to 200 psi over the entire platen area. Pressures applied during the bonding cycle can be program-controlled.

# **New Books and Publications**

MALLEABLE IRON CASTINGS. 526
pages; illustrated; 6 by 9 inches.
Published by Malleable Founders Society, 781 Union Commerce Building, Cleveland 14,
Ohio. Price, \$10.

This work reflects the authoritative knowledge of the malleable industry's foremost foundry technicians and casting designers. The editors have taken into account the industry's progress in recent years, expanding the content of new publication by more than 40 per cent over the previous edition, published in 1944.

New emphasis has been given to the description of pearlitic-malleable iron. This steel-like material offers greater hardness and wear resistance than ferritic malleable, but has sufficient ductility and machinability to make it ideal for many moving-part applications—gears, hubs, sprockets, and crankshafts.

Since machinability is one of malleable iron's outstanding characteristics, this subject is also covered in detail. Included in the machining chapter are discussions of all the basic operations.

MANUAL OF MACHINABILITY AND TOOL EVALUATION. By Antoni Niedzwiedzki. 107 pages; spiralbound; 58 figures, graphs, and tables. Published by Huebner Publications, Inc., 1975 Lee Road, Cleveland 18, Ohio. Price, \$6.

This new book bridges the gap between theory and practice, and between European and American concepts of machining with carbides and high-speed-steel tools. The ideas put forth by many technical groups both here and abroad have been absorbed, evaluated, and analyzed by the author, and have been combined with the results of his own experiments, calculations, and observations. The manual shows how it is possible to predict the amount of tool wear obtained in a given cutting time from a given set of machining conditions. It also shows how it is possible to calculate power consumption in advance of actual machining.

INGENIOUS MATHEMATICAL PROB-LEMS AND METHODS. By L. A. Graham. 237 pages; illustrated; 5 3/8 by 8 inches. Published by Dover Publications, Inc., 180 Varick St., New York, N. Y. Price, paperbound, \$1.45.

For eighteen years, workers in applied mathematics and fans of mathematical puzzles all over the world have supplied some of the most provocative problems in print to the puzzle column of the Graham "Dial." One hundred of the best problems have been selected for this book. The greater part of the volume concerns the technique of finding the solutions. Several methods by which a particular problem may be answered are given, and the reason why one method is preferable and where others fail is carefully explained.



Still another practical advantage of the Seneca Falls Model Q Lathe is its open front design which makes it easy to load and unload. Note that parts are loaded waist high, and it's less than a ten inch reach from the front of the machine to

Less operator fatigue... better production all day long.

Write for Bulletin Q-59 today for the full story.

ENECA ALLS ACMINE

Mechanical feed to all carriages.

Straight line diameter adjustment for

Four speed headstack available with

Feed rate can change during cutting

Templates clear of chip area.

Easy to load and unload.

automatic speed change.

tracer tools.

DO tell us your troubles. If turning, centering or automation are involved, most likely we can do more than sympathize

the centerline.

SENECA FALLS, MACHINE CO. SENECA FALLS, N. Y.



# SPUR GEARS for Every Need!

This trio is representative of Stahl's tradition of precision-in-quantity. These steel spur gears have identical specifications - 72 T., 2" C.P., and 6" F. Two are fitted with bronze bushings. A 45" Universal Slabbing Mill is their destination. General-purpose or highly special-

ized, Stahl makes them all, **EXACTLY** to specification, promptly and economically. Get our estimate.

COMPANY

3901 HAMILTON AVENUE CLEVELAND 14. OHIO

For more data circle Item 323A on Card

SPURS TO 72 .PD. 1 DP BEVELS TO 54 PD 1 DP SPIRAL HELICAL and WORM GEARS TO 48 PD 2 DP

CONTINUOUS TOOTH HERRINGBONE SILENT GEARS, RAWHIDE BAKELITE FIBROIL

HARDENED GEARS— OF CARBON OR ALLOY STEEL

# TESTED ELECTRICAL PROCEDURES DESCRIBED BY AN EXPERT



ELECTRICAL TESTING AND TROUBLESHOOTING, by Philip T. Green explains tested procedures clearly and completely.

This book will show you how to locate and correct faults in circuits

of all kinds, including-controllers, motors, transformers and transmission lines. A briefing on electrical symbols and diagrams is followed by detailed discussions on: Analyzing and charting controller operation, Insulation testing, Electromagnet winding, Single-

Phase transformers, Polyphase transformers, Synchronous motors, Troubleshooting test equipment, Locating grounds, D.C. machine windings, Phase sequence, Induction motors, Power cable faults, Bearing lubrication.

The tests are performed with the equipment isolated from the power line. Current is supplied by dry cells or residual magnetism so that accidental contact and short circuits are less hazardous. All of the trouble shooting procedures described here have been tested and proven to be great time-savers especially for locating obscure source of trouble. 200 Pages, 100 Illustrations, Flexible Fabrikoid Binding, \$5.00.

To order, you may use the handy yellow card that is next to the last page.

THE INDUSTRIAL PRESS 93 Worth Street, New York 13, N.Y. \*Anything you need in a drill press feed ...



ELECTRICALLY CONTROLLED AIR FEEDS. Drilling **Drilling-Tapping Models.** Beckett electrically controlled feeds provide proper thrust and correct drilling/tapping action for work in almost any material. Drilling-tapping models will tap direct from drill chuck, eliminating tapping heads, clutches, leadscrews, etc. Standard duty model has 2½" stroke and 740 lbs. max. thrust; heavy-duty model has 4" stroke and 1250 lbs. max. thrust, on pinion shaft at 100 psi air pressure.



MECHANICALLY (manually) CONTROLLED AIR FEED for drilling operations has same sensitive drilling action as electric feeds. Action is controlled by manually activating precision Beckett Hi-Cyclic Air Valve. Standard and heavy-duty models have same stroke and max. thrust as electric models described above. Superaccurate depth control and automatic dwell.





GEARED HEAD AIR FEEDS. Mechanically or electrically controlled. Beckett Geared Air Feeds provide either greater drill point thrust with shorter stroke, or a

longer stroke at reduced thrust, than the feeds described above, without adding to length of power transmission arm. Outside gears are pick-off type and interchangeable. Stroke and thrust can range from 8" stroke at 625 lbs. max. thrust, to 2" stroke at 2500 lbs. max. thrust, on 1 ½" pinion shaft at 100 psi.



#### HYDRAULIC FEEDS FOR AUTOMATING LARGER DRILL PRESSES.

Here is a complete hydraulic power package that can be tailored to your drill presses and your work requirements. Drill point thrust in excess of 5000 lbs. is obtainable on most equipment, as are approach speeds of 1" per sec. Feed speed is infinitely variable. Unit consists of heavy-duty power transmission arm and portable console housing control valves, hydraulic pump and tank.



OFT FULL DETAILS TODAY. WRITE FOR NEW CATALOG FM-60.



# BECKETT-HARCUM CO.

W. LOCUST STREET, WILMINGTON, OHIO

For more data circle Item 323B on Card

# (Coming Events continued from page 318)

ter, Philadelphia, Pa. For additional information: Chester L. Wells, exposition manager, American Society for Metals, Metals Park, Novelty, Ohio.

November 14-18—Third Western Tool Show sponsored by the American Society of Tool Engineers, to be held at the Memorial Sports Arena in Los Angeles, Calif. For additional information write Leonard Abrams, exposition manager, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.

# **Obituaries**

DANIEL F. AHLBERG, executive engineer and export manager of Michigan Tool Co., Detroit, Mich., died in April. Mr. Ahlberg joined Michigan Tool in 1924. In recent years he had also served the company as office manager and as chief security officer in connection with projects for the armed services.

A. S. BLADGEN, chairman of the Federal Machine & Welder Co., Warren, Ohio, died on May 10 at the age of eighty. After varied experience in fields related to the machine tool industry, Mr. Bladgen became associated with Federal Machine in 1945. He was elected president in 1949 and board chairman in 1957. In World War II he won a special citation from the chief of Army Ordnance in Washington.

# Zinc Die-Casting Award

In recognition of the important contributions made by the die-casting engineer to the present stature of the die-casting industry, the New Jersey Zinc Co. is sponsoring a \$1000 cash award to be known as "The New Jersey Zinc Company Zinc Die Casting of the Year Award."

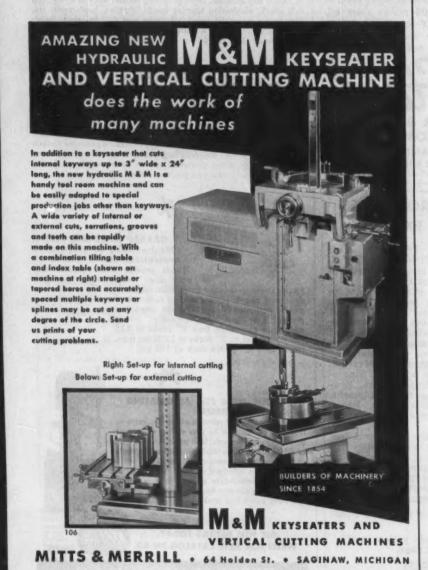
All producers of zinc die-castings are invited to enter this competition and the award will be made to the person who, in the opinion of his employer, and as reported with the entry, contributed most of the successful design and production of the

There is no limit to the number of entries that can be submitted by diecasting producers, provided the castings were made after May 1, 1959. All entries must be received by the New Jersey Zinc Co. or postmarked not later than midnight, July 31, 1960. Further information about the contest and entry forms may be obtained from the Market Development Division, New Jersey Zinc Co., 160 Front St., New York 38, N. Y.

# Measurement Standard for Length May Change from Metal to Light

What is expected to be a major development in improved standards in length is under development at the U. S. Bureau of Standards, according to R. D. Huntoon, deputy director. The incumbent fundamental standard of length, a platinumiridium meter bar, will probably be replaced by a train of light waves, consisting of a certain number of wave lengths of the orange light emitted by Krypton-86 lamps.

This change, which the International Commission on Weights and Measures is expected to adopt this year, will permit significant increases in the precision of length measurement. Experiments toward an even more precise measurement standard than Krypton-86 light waves are in progress. By this ultimate method fine streams of atoms in a vacuum promise an even more highly precise length measurement standard.





# Severance ELECTRODE DRESSING CUTTERS

Used by many to re-condition Electrodes without removing from machines-



Down-time is Slashed!

Production is Increased!

Designed to fit most all popular Electrode Dresser power tools. Special shapes quickly made up.



INUESTIGATE!

ASK FOR MORE INFORMATION TODAY!

OUTSIDE



DEBURRING



MIDGET

MILLS

CHATTERLESS

HAND DEBURRING CUTTERS

INSIDE DEBURRING CUTTERS







Severance TOOL INDUSTRIES INC. 636 Iowa Avenue SAGINAW, MICHIGAN

SERVICE

For more data circle Item 325A on Card

# NEW (TAUSE) VERNIER CALIPER

STAINLESS STEEL HARDENED THROUGHOUT FULLY LUSTRO-CHROME SCALE AND VERNIER

For Outside, Inside and Depth 6-1/4" Measuring Capacity



more data circle Item 325B on Card

# RS-ALL MAKES... PRECISION GEARS UP TO 200 DIAMETRAL PITCH

All Gears certified for Accuracy Quality and Fine Workmanship

NEW JERSEY GEAR & MFG. CO.

For more data circle Item 325C on Card Hillside, N. J.



# IMPROVE FACING OPERATIONS

ON BORING MILLS - DRILLS - LATHES MILLERS AND RADIALS

M-D facing Head feeds automatically. Lathe tool bit travels radially from center outward or reverse, 10 sizes, 6" to 46" die. Write for bulletin, prices.

MUMMERT-DIXON CO. 126 Philadelphia St.

For more data circle Item 325D on Card

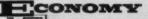
MACHINERY, June, 1960



Whether for manufacture, installation, maintenance or repair, a power-operated portable telescoper puts you exactly at working level safely and conveniently, thus cutting "down" time and increasing production.

And Economy can specially engineer such telescopers for any application, for machinery of any size and type, as we have been doing for over 60 years.

WRITE FOR MORE INFORMATION



NGINEERING

4517 W. Lake Street Chicago 24, Illinois

For more data circle Item 325E on Card

# Microfilm Catalogue File **Cuts Searching Time**

A new industrial communications system designed to speed production in the nation's aircraft and missile industry is called "VSMF-The Microfilm Catalog File." With it, engineering time spent in searching for product and specification data can be reduced about 90 per cent. This new system was developed by the Technical Services Division of Rogers Publishing Co., Denver, Colo., in collaboration with the Recordak



ON YOUR PRODUCTION LINE

Get pressure where you need it with a

# FORCING PRESS

150 TONS to 1 TON **GAP OR COLUMN TYPES** 

HIGH SPEEDS · LOW PRICES





- 1. All-steel welded frames-normalized.
- 2. Steel-head, heavy-duty cylinders. 3. Induction case-hardened rams.
- 4. Wide choice of ram speeds.
- 5. Built-in power units. 6. Wide choice of controls.
- 7. Special loading and unloading mechanisms

where needed.

Call in your nearby Hannifin man-he's a trained production analystfind out how you can do more at lower costs with Hannifin presses. Or, write for our new Bulletin 130-G. It tells the whole story.

## HANNIFIN COMPANY

509 South Wolf Road . Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION-

Corporation, a subsidiary of the Eastman Kodak Co.

"VSMF" units consist of a microfilm file, a reader, and a photocopying device which add up to a high-speed, easy-to-use facility for storing, retrieving, and rapid review of technical literature. The user first looks up the item in which he is interested in a copyrighted, cross-referenced index that refers him to the reel of microfilm containing the desired information. This reel, or magazine, is inserted in the viewing machine. By means of a high-speed control switch the particular page can be located within fifteen seconds.

A magnified image of the catalogue page appears on a 13-inchsquare screen. The information can be read directly from the screen or. if the user wishes to have the data at his desk, a black-and-white copy of the page being projected can be made quickly by the photo-copying device on top of the reader. Included on each reel of microfilm are lists containing the name and address of each supplier's nearest sales office.

The first edition of "VSMF" was produced for the missile and aircraft industry and contains more than 25,000 pages of product information from 1300 suppliers. This information is recorded on twentytwo reels of microfilm, which will be revised and up-dated every four months. Other editions are to be published later this year for the communications and automotive industries, with three more to follow in 1961.

The system is leased to user companies at an annual rental fee which includes all expenses except photographic paper for copying.

# **EUROPEAN COMMON MARKET**

JOINT VENTURE - SELLING AGENCY

Belgian Manufacturer of steel flanges, in a fully equipped 110,000 sq. ft. plant including presses up to 600-ton seeks an American Company interested in having its own stampings produced and sold in Europe.

Instead of an association would consider the sale of the existing plant.

WRITE:

Leon G. Rucquoi & Associates, Inc.

30 Rockefeller Plaza New York 20, N. Y.

For more data circle Item 327A

NEW! ENLARGED SECOND EDITION!

# MACHINERY'S MATHEMATICAL TABLES Edited by Holbrook L. Horton

MACHINERY'S MATHEMATICAL TABLES has been MACHINERY'S MATHEMATICAL TABLES has been serving mechanical engineers, machine designers, draftsmen, toolmakers, machinists and students for over 30 years! Now it is available in a greatly enlarged version, containing the authoritative, easy-to-use mathematical regular information you need on the job. Designed for speed and utility, you can now use its "edge index" to flip to any desired place in the book instantial. instantly.

The convenient pocket-size, its semi-flexible covers, and thin strong pages make it the ideal everyday referce book to have. 254 pages. \$3.75

THE INDUSTRIAL PRESS, 93 Worth St., N. Y. 13

# DO YOU BEND?

"A MANUAL OF PROCESS for THE COLD BENDING OF METALS and ABRASIVE CUT-MACHINING OF METALS" gives practical advice on all phases of cold bending and abrasive cutting. Simply written by shop men for shop men. Price \$3.00.

Wallace Supplies Mfg. Co.
1310 West Diversey Parkway Chicago 14, Illinois

For more data circle Item 327B



# KAFER

Precision dial gauges

The Best of German craftsmanship Dealer inquiries invited. Classic Machine Imports 14 Imrie Street, Randolph, Mass.

For more data circle Item 327C

MACHINERY, June, 1960



WICKESmanship

"TURNS UP" more profits for your crankshaft production



Here's crankshaft production efficiency that results in lower initial and unit costs for every job . . . guaranteed by an outstanding record of customer satisfaction over the years. Dispensing customer satisfaction is standard procedure at WICKES Machine Tool-and it shows up in the only complete line of CRANKSHAFT LATHES built in the world today. Call your WICKESman-let him show you how WICKESmanship can help you produce more



For more data circle Item 327D

For more data circle this page number on card at back of book

# 3 USEFUL BOOKS FOR PRODUCTION ENGINEERS



ENGINEERED WORK MEASUREMENT by Delmar W. Karger and Franklin H. Bayha.

An up-to-date, complete text on Methods-Time Measurement, the internationally recognized predetermined time systems, this book covers MTM thoroughly, expertly. Fourteen chapters describe the fundamentals of MTM, such as Reach, Move, Grasp, Release. Every term is clearly defined and illustrated. Special MTM mathematics, standards and applica-tions, as well as organization and development of MTM training courses are covered. Engineered Work Measurement will help you in providing standard data and time formulas, controlling labor costs, evaluating existing systems, improving methods and estimating production costs.

630 pages, 130°illustrations. \$12.00



INSPECTION

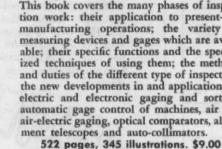
and GAGING

DIMENSIONS AND TOLERANCES FOR MASS PRODUCTION By Earle Buckingham.

An analysis of the many problems of dimensioning with tolerances for mass production, showing their effect on tool design, gage design, production and inspection, and suggesting improved methods and practices to solve these problems. Worked-out examples show how improved methods and practices of dimensioning with tolerances can be the key to better production at lower costs. This book will help you develop sounder, more practical procedures, not only in the design stage, but also in manufacturing, inspection and assembly.

164 pages, 179 illustrations. \$8.00

INSPECTION AND GAGING By Clifford W. Kennedy.



This book covers the many phases of inspection work: their application to present-day manufacturing operations; the variety of measuring devices and gages which are available; their specific functions and the specialized techniques of using them; the methods and duties of the different type of inspectors; the new developments in and applications of electric and electronic gaging and sorting, automatic gage control of machines, air and air-electric gaging, optical comparators, alignment telescopes and auto-collimators.

THE INDUSTRIAL PRESS, 93 WORTH ST., NEW	YORK 13, N. Y.
Please send me the book(s) I have checked below.	
1. Engineered Work Measurement     2. Dimensions and Tolerances For Mass Production	☐ Bill me ☐ Bill Company
☐ 3. Inspection and Gaging  Orders from outside U.S. except Canada add 50¢for postage a	Payment Enclosed
Name	
Cempany	
Address	
City Zone	State

# SAVE ON PIPE

FOR ALL METALWORKING NON-PRESSURE & STRUCTURAL PURPOSES

Buy FOSTER STRUCTURAL PIPE-ideal for guard rails, fence posts, and machinery parts, at big savings—even in small lots.

All Sizes-Cut-to-Length Black or Galvanized 1/2" 3/4" 1" 1-1/4" 1-1/2" 2" 2-1/2" 3" 3-1/2" 4" and 5" through 36"

One ton to multiple carloads of a size

SEND FOR STOCK LIST

Let us quote you "Faster From Foster"

L. B. FOSTER CO.

PITTSBURGH 30 CHICAGO 40 LOS ANGELES 5 NEW YORK 7 HOUSTON 2 ATLANTA 8

CLEVELAND 35

# **ASME Announces New Nut and Bolt** Publication

A new publication to help engineers design threaded parts such as nuts and bolts that will lock with each other has been announced by The American Society of Mechanical Engineers and the American Standards Association. Title of the publication is Trial American Standard Class 5 Interference-Fit Threads, B1.12.

# Classified and Resale Section

CLASSIFIED ADVERTISING RATES: \$12 per single column inch

# at its Best



Shown is a Miles mechanic preparing the seriam of a new alsonium bronze wearing piats for proper intrication. This is typical of all Miles re-building at its very best.

LATHE, TURRET, No. 2. W & S new electric har feed, hi-to meter

LATHE, TURRET, No. 4L Gisholt by. dy. namidle type, cross feeding turret.

LATHE, TURRET, No. 4L Gisholt by. dy. namidle type, cross feeding turret.

LATHE, 27 swing S ee Betts Bridgeford geared MILLS, PRODUCTION, No. 33 Soustrand Findacerew Righdmil hed type, Timion bearings, (2) MILLS, PRODUCTION, 34-756 Ginelineati depix hymerical miles, PRODUCTION, 35-756 Ginelineati depix hymerical miles hymerical miles

"C" frame
PRESS, PUNCHING, 70 ton No. 35P Toledo, solid
Annes, MD
ROLL, No. 18 Kane & Boach straightening, 21/2" capacity
SAW. 10½" x 10½" No. 3 Motth & Merryweather
circular coid metal, late
SMAPER, 28" & E industrial, by. dy., now 42 (2)
UPSETTER, 4" National sir circle, air brake, late

OVER 1,000 NEW AND USED MACHINE TOOLS IN STOCK WRITE FOR LATEST STOCK LIST

MILES MACHINERY COMPANY

2045 EAST GENESEE . SAGINAW, MICH. PL 2-3105

# astern Rebuilt Machine Tools

# THE SIGN OF QUALITY \_ THE MARK OF DEPENDABILITY

The listing below is only a VERY SMALL AMOUNT of the total number of machine tools that we have in stock for immediate shipment. Our prices are realistic with today's market and our quality of rebuilding is the same high standard—THE LEADER IN THE FIRED OF RESULTA MACRIENT TOOLS.

FREDES
No. 6 Verdin, Kappes & Verdin Straight Side
No. 6F E. W. Bliss Three Crank Cupping Press
No. 164% Toledo Tengle Drawing & Deep Stamping
Toledo Tengle Drawing & Deep Stamping
Toledo Tengle Drawing & Deep Stamping
Toledo Wood M del 8229 Vertical Hydraulic, 4 col.
single settion-down
500 ten Nules Herisontal Wheel Press
Type 8750 Heensine Hydraulic Straightening, m.d.
Model H Cirvland 0.B.I. Punch Press, belt drive
No. 3AA Cance (American Can Co.) Open Back Inclinable Punch Press, m.d.

#### PROFILERS

Model M. 2416 Pratt & Whitney Keller Type, m.d. No. 12B Pratt & Whitney Model 1693, 2 spindle, 1944 No. 12M Morey, 2 spindle, m.d., 1943 4 spindle 360° Cincinnati Automatic, m.d., 1944 30° capacity 2 spindle Pratt & Whitney Vertical Miller & Fredler, Model 1482

#### FUNCHES & SHEARS

No. 5 Hilles & Jones Punch & Shear, single end, type G. No. 7 Thomas Vertical latest

#### BAILROAD MACHINERY

3 Niles Axle Lathe, m.d. 2 Niles-Bement-Pend Axle Lathe, m.d. 'Betts Hydraniic Feed Car Whoel Borer & Facer, belt

or Niles-Benent-Pend Car Wheel Lathe, m.d.

9° Niles-Benent-Pend Car Wheel Lathe, including
2 inside Sournal Turning Lecomotive Lathe, including
2 inside Sournal turning and 3½" spindle double
gustlering statch, m.d.
50 inside Sournal turning and 3½" spindle double
gustlering statch, m.d.
Chambies Drying Wheel Lathe, m.d., latest
Chambies Mounting & Dismounting H.S. Deplex Car
Wheel Type Mounting & Dismounting H.S. Deplex Car
Wheel Rollanced Quartering & Crank Pin Turning
Maching, m.d.
48" Niles Car Whoel Borer

No. 4B Robertson Economy, m.d., new No. 4XE Robertson Economy, m.d., new No. 32B Cochran By Saw, m.d., latest Model 102, Type JCAW, Cincinnati Elec. Teal & Abranive Cut-off, m.d. Model 401 Cutomatic Abrasive Cut-off, m.d. 678" Poeriesm High Duty Hydraulic Standard, m.d. 10x10" Puerlem Hydraulic Power Hack Saw, m.d.

#### CHAPERS

6" Pratt & Whitney M1506, Model B Vertical 12" Rockford Universal Hydradise, flanged m.d. 12" Hondey Universal Back Gared, m. 12" Hondey Universal Back 24" Gameo Standard Duty Universal, m.d. 24" American Standard Futern Auto-Offed Plain Shaper,

24" Rockford Hydrarlie, m.d. 32" Morton Draw-Cut, m.d., late 32" Cincinnati, m.d., late 32" Cincinnati, m.d., late 38" Morton Push Cut Shaper, m.d. 48" Morton Heavy Duty Traveling Head, m.d.

#### SHEET METAL MACHINERY

No. 3 %" canacity Gray Sheet Metal Cutter, m.d. No. 11-8HC Buffalo Armor Plate Bar Cutter, m.d. Model 1236 Libert High Speec Nibbler Type Shear, m.d. No. 5 Hilles & Jones Pyramid Type Bending Roll Model U1144B Parks Underdriven Power Squaring Sbear Model SP Dreis & Krump Hand Type Box and Pan Brabe

#### SLOTTERS

18" Niles-Bement, a.p.d. 20-24" Pattern Dill, m.d. 20" streke Rockford, m.d. 22" Betts, m.d. 48" Niles, m.d.

#### TAPPERS

No. 1 Bakewell, m.d., late No. 10 Model 2100 Warner & Swassy Bench Model, m.d. No. 11 Warner & Swassy, m.d.

#### TURRET LATHES

Model RSM-59 Hardings Precision Ram Type, m.d.

Ke. 1 Warper & Brandy "Electric", m.d., bar

No. 18-25 Acras Sandy "Electric", m.d., bar

No. 18-25 Acras Sandy "Electric", m.d., bar

No. 14 Warner & Swaney, m.d. 142

No. 2 Bardons & Oliver Ram Type Electric, m.d.

No. 2 Bardons & Oliver Ram Type Electric, m.d.

No. 2 Bardons & Oliver Ram Type Electric, m.d.

No. 3 Glabolt, m.d., 1945

No. 4 Midiand Universal Ram Type, m.d.

No. 4 Midiand Universal Ram Type, m.d.

No. 4 Glabolt, 1943

No. 4 Werner & Swaney Universal Bam Type, m.d.

No. 4 Werner & Swaney Universal, m.d., chacking, 1939

No. 4 Werner & Swaney Universal, m.d., chacking, 1939

No. 4 Werner & Swaney Universal, m.d., chacking, 1939

No. 4 Werner & Swaney Universal, m.d.

No. 4 L Gibbolt, Universal Mellow Hexagon, m.d.

No. 5 Gisholt, 1946

No. 5 Gisholt, Ram Type, m.d.

#### UNIVERSAL MILLING MACHINES

No. 2 Brown & Sharpe Light Type, Flanged, m.d., late
No. 3A Brown & Sharpe Standard Type, m.d., late
No. 3K Kenney & Tecker, m.d.
No. 5 Cincinnati H.P. m.d., late
No. 2ML Cincinnati, m.d., late
No. 2MLU Van Norman Ram Type, m.d.

WRITE FOR COMPLETE STOCK LISTING

The above is only a partial listing

MACHINERY COMPANY EASTERN

1006 Tennessee Avenue, Cincinnati 29, Ohio • MElrose 1-.1241 • Cable Address EMCO

BOOKS...give you the answers to your design and production problems. And it's easy to get them by mail. Just read the descriptions on the insert opposite the back cover, and use the prepaid order card to get the ones you want.

# No other tracer attachment has all these features

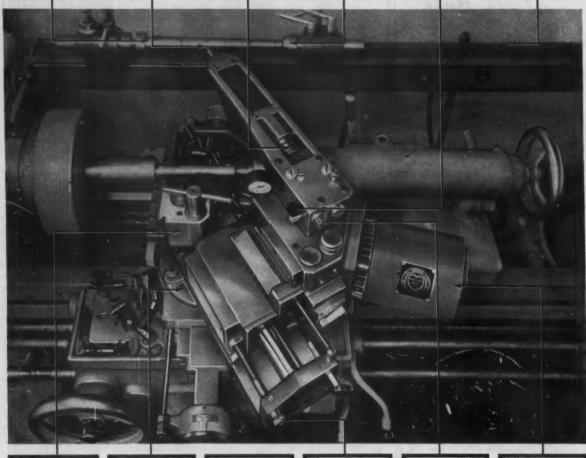
Traces from any template (round, flat, wood, metal) or standard product. Tracer controls tool in continuous path for smooth, accurate finish.

Micrometer adjusts for cutting over, under or exact size.

Adjustable eccentric on template protects lathe tailstock.

Easy-to-reach control knob initiates or interrupts cycle.

Template rails furnished any length and with brackets to fit any lathe.



Tool post and holders designed for quick change of pre-set tools. Complete swiveling for turning, boring or internal cutting at any angle. Does not limit utility of lathe . . . regular turning can be done with tracer installed.

Positive stop locks unit for non-tracing cuts.

Adjustable valve controls feed rate for non-tracing work

Close-coupled motor and pump eliminates hoses, assures sensitive control.

For far less than you would imagine, you can quickly convert any good lathe for turning multiple diameter shafts or for turning, facing and boring contoured workpieces . . . single pieces or high production. Three sizes to fit any lathe up to  $27\frac{1}{2}$ " swing and up to 30 horsepower.

Write for complete information.



330

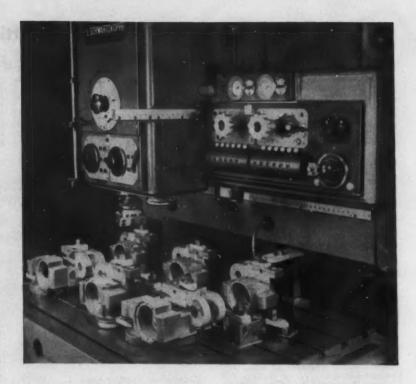
LELAND-GIFFORD

HYDRAULIC LATHE TRACER ATTACHMENT

# Alphabetical Index of Advertisers

Allegheny Ludlum Steel Corp 278 Allen-Bradley Co	Friden, Inc	Oakite Products, Inc
Allen Manufacturing Co.         286           American Brass Co.         103           American Tool Works Co.         45	Gardner Machine Co 25 Giddings & Lewis Machine Tool	Opto-Metric Tools, Inc 320 Orban, Kurt, Co., Inc 219
Ames, B. C., Co	Co	Pangborn Corp 336
Armstrong-Blum Mfg. Co 299 Armstrong Bros. Tool Co 46	Gillen, John, Co 306	Pannier Corp. 312 Parker-Hannifin Corp. 326
Armstrong Bros. Tool Co 46	Gisholt Machine Co Insert 33-36	Parker-Hannifin Corp 326
Atlas Press Co., Clausing Div 220	Gleason Works 59	Pratt & Whitney Co., Inc. (Potter
	Goss & DeLeeuw Mch. Co 276	& Johnston Machines) 297
Baldwin-Lima-Hamilton Corp., Industrial Equipment Div 37	Gray, G. A., Co	Producto Machine Co 85
Parker Column Co	United Greenfield Corp 269	
Barber-Colman Co Insert 78-79	Greenlee Bros. & Co Insert 85	Reliance Electric & Engrg. Co 267
Bardons & Oliver, Inc 91 Barnes Drill Co 235		Reeves Pulley Co., Div. Reliance
Barnes, W. F. & John Co. Insert 80-81	Hamilton Electrona, Inc 229	Electric & Engineering Co 267
Beckett-Harcum Co 323	Hannifin Co., Div. Parker-	Revere Copper & Brass, Inc 107 Rockford Machine Tool Co.
Bendix Corp 40-41	Hannifin Corp 326	Insert 76-77
Bethlehem Steel Co 47, 281	Hardinge Brothers, Inc 24, 118	Rockwell Mfg. Co., Delta Power
Blanchard Machine Co 309	Heald Machine Co., The	Tool Div
Bliss, E. W., Co	Hill Acme Co	Rucquoi, Leon G. & Assoc., Inc. 327 Russell, Burdsall & Ward Bolt
Boston Gear Works         291           Brook Motor Corp.         290           Buffalo Forge Co., Machine         56-57	Hydraulic Press Mfg. Co 241	Russell, Burdsall & Ward Bolt
Buffalo Forge Co. Machine		& Nut Co 237
Tool Div 56-57	Induction Heating Corp 333	Ruthman Machinery Co 296 Ryerson, Joseph, T. & Son, Inc. 120
Buhr Machine Tool Co 244-245	Industrial Distributors (Sales), Ltd	tyerson, Joseph, 1. & Son, Inc. 120
Bunting Brass & Bronze Co 313	Ltd 60-61	CVF Industries Inc. 999
Burg Tool Manufacturing Co., Inc 30-31	Innocenti Corp 301	SKF Industries, Inc
Inc 30-31	Jacobs Manufacturing Co.	Scherr-Tumico Co 325
		Schrader's A., Son, Div. Scovill Mfg. Co., Inc
Cameron Iron Works, Inc 95	Front Cover, 48-49 Jones & Lamson Machine Co.	Mfg. Co., Inc 205
Carlton Machine Tool Co 109	207, 209, 211, 213	Seneca Falls Machine Co 322
Chambersburg Engineering Co 292		Severance Tool Industries, Inc 325
Chicago Latrobe	Kearney & Trecker Corp 26-27	Sheffield Corp. 295 Shenango Furnace Co. 298 Skinner Electric Valve Div.,
Cincinnati Gear Co 282	Kennametal, Inc 317	Shenango Furnace Co 298
Cincinnati Lathe & Tool Co 52-53	Kingsbury Machine Tool Corp 63	Skinner Chuck Co Insert 101-102
Cincinnati Milling Machine Co.,	Laminated Shim Co., Inc 116	Slocomb. J. T. Co
Special Machine Div. 6-7	Landis Machine Co 2-3	Slocomb, J. T., Co
Cincinnati Milling Machine Co.,	Landis Tool Co 8-9	Springfield Machine Tool Co 96-97
Metal-Dynamics Div 303	LaSalle Machine Tool, Inc 105	Stahl Gear & Machine Co 323 Standard Tool Co 90 Stuart, D. A., Oil Co., Ltd 201-204
Cincinnati Milling Products Div.,	LaSalle Machine Tool, Inc 105 Latrobe Steel Co 287	Standard Tool Co 90
Cincinnati Milling Machine Co.	LeBlond, R. K. Mch. Tl. Corp. 86-87	Stuart, D. A., Oil Co., Ltd 201-204
43, 51   Cincinnati Shaper Co. 18-19   Classic Imports 327   Classified Advertisements 328-329	Leland-Gifford Co 330	Sundstrand Machine Tool Co.,
Classic Imports	Lincoln Electric Co 54-55	Div. Sundstrand Corp. Insert 82-83 Superior Hone Corp 318
Classified Advertisements 328-329	Linde Co., Div Union Carbide	Superior Hone Corp 318
Clausing Div., Atlas Press Co 220	Corp	
Cleco Div., Reed Roller Bit Co 257	Machine Co., The Insert 255-256	Texaco, Inc. 311 Thomson Industries, Inc. 223
Cleveland Automatic Machine Co. 227		Throndwell Ton & Die Co
Cleveland Crane & Engrg. Co 66	Machine Products Corp 225	Threadwell Tap & Die Co. Inside Back Cover
Cleveland Punch & Shear Works Co	Machine Tool Exposition 42	Thriftmaster Products Corn. 89
Columbia Tool Steel Co 320	Macklin Co	Thriftmaster Products Corp 62 Timken Roller Bearing Co.
Columbus Die-Tool & Mch. Co 300	Madison-Kipp Corp 280 Marac Machinery Corp 332	104: Back Cover
Cosa Corp	Marlin-Rockwell Corp 252	Tomkins-Johnson Co 275
Cross Co 16-17	Mattison Machine Works Insert 84	Ty-Sa-Man Machine Co., Inc 314
Crucible Steel Co. of America 92-93	Metallurgical Products Dept.,	
Cushman Chuck Co 249	Metallurgical Products Dept., General Electric Co 250-251	U. S. Tool Co., Inc 10-11
A transparency training appropriate	Michigan Tool Co 64-65	Union Carbide & Carbon Corp., Linde Co
Danly Machine Specialties, Inc. 259	Micromatic Hone Corp 284-285 Mitts & Merrill 324	Linde Co 260-261
Davis & Thompson Co 316	Madern Machine Tool Co. 979	Universal Engineering Co 44
Delta Power Tool Div. Rockwell Mfg. Co 270-271	Modern Machine Tool Co 278 Mohawk Tools, Inc	
Denison Engineering Div.	Monarch Machine Tool Co 307	Van Keuren Co 308
ABSCO 277	Moore Special Tool Co., Inc 50	Van Norman Machine Co 28-29
DeVlieg Mch. Co 216-217	Morton Manufacturing Co 321	Verein Deutscher Werkzeug-
Diefendorf Gear Corp 321	Mummert-Dixon Co 325	maschinen Fabriken (VDW) 100 Verson Allsteel Press Co
DoAll Co	N. H D N H C 00	Vickers, Inc 28
Dykem Co	National Broach & Machine Co. 32	
	National Machine Tool Builders	Wales Ctuinnit To
Eaton Manufacturing Co.,	Assoc. 42 National Machinery Co. 334	Walker O.S. Co. Inc 31
Farval Div 99	Nebel Lathe Div., Nebel Machine	Walker, O. S., Co., Inc 293 Wallace Supplies Mfg. Co 32
Economy Engineering, Inc 325	Tool Corp 305	Warner & Swasey Co 12-13
Eisler Engineering Co., Inc 321 Engis Equipment Co 304	Tool Corp	Wesson Co Insert 69-7
Ex-Cell-O Corp 253, 263	Nebel Lathe Div 305	Wickes Machine Tool Div
	New Britain Machine Co., The.	Wickes Corp
Fafnir Bearing Co 232	New Britain-Gridley Machine	Williams, J. H. & Co 27
Farval Div Eaton Mfg Co	New Britain Machine Co., The,	Wood, R. D. Co 20-2
Farval Div., Eaton Mfg. Co 99 Federal Machine & Welder Co 294	Lucas Machine Div. Insert 255-256	W. 1. 0
Federal Products Corp 39	New Jersey Gear & Mig. Co 325	Yoder Co 5
Fellows Gear Shaper Co 4-5	Niagara Mch. & Tl. Wks 247	
Fosdick Mch. Tl. Co 88-89	Norton Co 14-15, 72-73	Zagar, Inc 9

Stainless Steel Atomic Grid
Plates 6 feet in diameter and
10 inches thick—as well as
small, high precision Gear
Boxes shown in the righthand picture—can be bored
and milled equally advantageously on the



# SCHWARTZKOPFF



NUMERICALLY CONTROLLED PRECISION BORING AND MILLING MACHINE-KBF2

Other Features:

Capacity: 50" long

30" wide

48" high

Pre-selector for feeds and speeds.

Push-button control throughout.

Rapid power traverse of spindle

up and down.

Power tool lock.

Hand positioning for small lots

possible.

Lead time practically nil at practically NO COST.

For full particulars write or phone

# MARAC MACHINERY CORPORATION

108 Grand Street White Plains, New York Telephone: WH6-0920

332

# free literature guide

Want more information? Below are listed the products described in this issue. Page number after company name refers to location of ad and number to be circled on cards for literature.

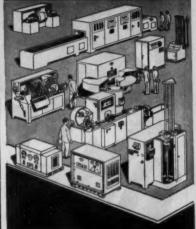
This guide is compiled as a convenience to our readers. Every care is taken to keep it accurate.

Machinery assumes no responsibility for errors or omissions.

\*Advertisement appeared in preceding issue.

AIR TOOLS, PORTABLE	CARBIDE TOOLS & DIES
Aro Equipment Corp *	Tinegrenj Lucium, Carmer
Duckeye 10018	Metal Carbides Corp
Chicago Pneumatic Co 264-265 Cleco div. Reed Roller Bit Co 257	Metallurgical Products dept. General Electric 250-251
ALUMINUM	CASTINGS
Ryerson Steel 120	Meehanite Metal Corp *
BAR MACHINES, AUTOMATIC	CHIPBREAKERS Kennametal, Inc
Cleveland Automatic Mch. Co. 227	Kennametal, Inc 317
New Britain Machine Co 110 Pratt & Whitney Co., Inc 297	CHUCKING MACHINES, AUTOMATIC
	Goss & de Leeuw Machine Co. 276
BEARINGS	New Britain Mch. Co 110 Warner & Swasey Co *
Ball & Roller Bearing Co	CHUCKS
Federal Bearing Co	Cushman Chuck Co 249
	Hardinge Bros., Inc 24
Marlin-Rockwell Corp 252 SKF Industries 239	Jacobs Mfg. Co 48-49
Timken Roller Bearing	Walker, O. S. Co 293
Co Back Cover	CLEANERS, METAL Oakite Products, Inc
BEARINGS, BRONZE	Oakite Products, Inc 38
Bunting Brass & Bronze Co 313	COLD FORMING EQUIPMENT
T MACAN SEVENS	Cincinnati Milling Mch. Co. Meta-Dynamics div 303
Bending Equipment, PIPE & TUBE Buffalo Forge Co 56-57	National Machinery Co 334
Wallace Supplies Co 327B	Yoder Co
BODING MACHINES	COLLETS
BORING MACHINES Ex-Cell-O Corp	Hardinge Brothers, Inc 24
Fosdick Mch. Tool Co 88-89	Jacobs Mfg. Co 48-49
Heald Mch. Co. Inside Front Cover	COMPONENT FABRICATIONS
Marac Mchry	Kirk & Blum Mfg. Co *
	COOLANT UNITS
BORING MILLS, HORIZONTAL Giddings & Lewis Mch. Tool	Little Giant Pump Co *
Co	CONTOUR MACHINES
	DoALL Co 100
BORING MILLS, VERTICAL American Schiess Corp *	CONTROLS, ELECTRICAL
Elmes/King div. American	Allen-Bradley Co 114
Steel Foundries	COPPER
Lucas div. New Britain Mch. Co 255-256	American Brass Co 103 Revere Copper & Brass, Inc 107
BRASS	CUT-OFF MACHINES Armstrong-Blum Mfg. Co 299
American Brass Co 103 Revere Copper & Brass, Inc 107	DoALL Co *
BUSHINGS, BALL	Grieder Industries *
	Modern Mch. Tool Co 278
Thomson Industries, Inc *	Ty-Sa-Man Mch. Co 314 Wallace Supplies Mfg. Co *
BUSHINGS, DRILL JIG	CUTTING & GRINDING FLUIDS
Ex-Cell-O Corp	
Universal Engrg. Co 44	Cincinnati Milling Products Div
CAMO	Standard Oil Co. (Indiana) *
Eisler Engineering Co 321C Rowbottom Mch. Co *	Stuart, D. A. Oil Co 201-204
Rowbottom Mcn. Co	Texaco, Inc 311

for Hardening - Brazing Soldering - Forging - Annealing Melting - Sintering - Welding Refining - Shrink Fitting Crystal Growing



# THER-MONIC

Manufactures the most complete range of

# INDUCTION HEATING

EQUIPMENT

MOTOR GENERATOR

THER-MONIC features

- Over 20 years of concentrated experience.
- Over 5,000 installations.
- Over 15,000 heating applications resolved in our customer service laboratories.
- This outstanding experience and know-how qualify us to prescribe the techniques and equipment best suited for your requirement.

Contact our factory or your local IHC representative.

Write for New 56-page catalog of exclusive features, facts and specs.

INDUCTION HEATING CORP. 181 WYTHE AVE., BROOKLYN 11, N.Y.

Circle this page number on card



These important parts are cold-formed from coiled wire, start to finish in compact, efficient National Cold Headers.

Three are formed with no scrap loss. Two are ready to use! All five achieve remarkable sav-ings over past methods.

If you make odd-shaped parts, may we help you evaluate them for cold-forming from wire? Better yet, come to Tiffin, witness our demonstrations and let's discuss your work.



Circle this page number on card

UTTING TOOLS	FORGING MACHINES
ce Drill *	Chambersburg Engrg. Co 292
hicago-Latrobe 289	Hill Acme Co 108
ontinental div. Ex-Cell-O * Idorado Tool & Mfg. Corp *	FORGINGS
Sohawk Tools, Inc 71	Cameron Iron Works, Inc 95
Vational Twist-Winter Bros *	GAGING & MEASURING EQUIPMENT
tandard Tool Co 90	Airborne Instruments *
Chreadwell Tap & Die Co *	Ames, B. C. Co 315
YLINDERS	Brown & Sharpe Mfg. Co *
ogansport Mch. Co	Classic Mch. Imports 227C Engis Equipment Co *
Comkins-Johnson Co 275	Federal Products Corp 39
HAMONDS, INDUSTRIAL	Scherr-Tumico 325B
Engelhard Hanovia div * Industrial Distributors, Ltd. 60-61	Sheffield Corp 295
	Slocomb, J. T. Co
DIE CASTING MACHINES	
B & T Mchry. Co *	GEAR CHECKING EQUIPMENT
Producto Mch. Co 85	Orban, Kurt Co., Inc *
	GEAR CUTTERS
DOWEL PINS	Barber-Colman 78-79
Allen Mfg. Co	Fellows Gear Shaper Co 4-5
Gillen, John Co 306	Gleason Works
DRESSING CUTTERS, ELECTRODE	National Broach & Machine
Severance Tool Ind 325A	Co
DRILL HEADS	GEARS
Thriftmaster Products Corp 62	Cincinnati Gear Co 282
Zagar, Inc 98	Diefendorf Gear Corp 321D
DRILL SHARPENERS	Illinois Gear & Mch. Co *
Cincinnati Lathe & Tool Co *	New Jersey Gear Co 325C Stahl Gear & Mch. Co 323A
DRILLING MACHINES	
American Tool Works Co *	GRINDING MACHINES
Baush Mch. Tool Co *	Blanchard Machine Co 309
Brown & Sharpe Mfg. Co *	Brown & Sharpe Mfg. Co * Cosa Corp *
Buffalo Forge Co	Heald Mch. Co *
Burg Tool Mfg. Co 30-31 Carlton Mch. Tool 109	Hill Acme Co * Mattison Machine Wks 84
Delta Power Tool Div 270-271	Mattison Machine Wks 84
Edlund Machinery Co *	Micromatic Hone Corp *
Giddings & Lewis Mch. Tool	Norton Co
Co	Sundstrand Mch. Tool Co 82-83
Moline Tool Co	Thompson Grinder
DRILL PRESS FEEDS	Van Norman Mch. Co 28-29
Beckett-Harcum Co 323B	GRINDING MACHINES, TOOL
	Oliver Instrument Co 115
ELECTRON BEAM, WELDING, MACHINING	GRINDING WHEELS
Hamilton Electrona, Inc 229	Cincinnati Milling Mch. Co.
FACING HEADS	Products div 43
Mummert Dixon Co 325D	Macklin Co 67
FASTENERS	Norton Co
Allen Mfg. Co 286	
Russell, Burdsall & Ward	HARDNESS TESTERS Clark Instrument *
Nut & Bolt Co 237	Shore Instrument & Mfg *
Safety Socket Screw Co 288	
FEEDING EQUIPMENT	HONING EQUIPMENT
Detroit Power Screwdriver *	Barnes Drill Co
FILTERS	Superior Hone Corp 284-285
Hydromation Filter Co *	
	INDUCTION HEATING EQUIPMENT
FINISHING MACHINES, METAL Osborn Mfg. Co	Induction Heating Co 333 Lepel High Frequency Labora-
Pangborn Corp 336	tories, Inc *
1	

JIG BORERS & GRINDERS
Austin Industrial Corp *
Moore Special Tool Co., Inc 50 Opto-Metric Tools, Inc 320A
Columbus Die-Tool & Mch. Co. 300
JIG MILLS
DeVlieg Mch. Co 216-217
KETSEATERS
Mitts & Merrill 324
LATHES
American Schiess Corp *
Barber-Colman Co
Cincinnati Lathe & Tool Co 52-53
Clausing div., Atlas Press Co. 220
Clearing div., U. S. Industries *
Gisholt Mch. Co
Hardinge Bros
LeBlond Mch. Tool Co 86-87
Monarch Mch. Tool Co 307
Nebel Mch. Tool Corp 305 New Britain Mch. Co 113
Rivett Lathe & Grinder *
Rivett Lathe & Grinder * Seneca Falls Mch. Co 322
Sheldon Mch. Co., Inc
Sundstrand Meh Tool Co 95-97
Warner & Swasey 12-13
Warner & Swasey 12-13 Wickes Mch. Tool Div 327D
LAYOUT FLUID
Dykem Co 321B
LUBRICANTS
Lubriplate div., Fiske Bros *
LUBRICATING SYSTEMS
Farval div. Eaton Mfg. Co 99 Madison-Kipp Co 280
Madison-Kipp Co 280
MARKING DEVICES (STAMPS)
Pannier Corp 312
MILLING MACHINES
Cincinnati Milling Mch. Co *
Clausing div. Atlas Press Co * Greaves Mch. Tool Co *
Morton Mfg. Co 321A
Sundstrand Mch. Tool 82-83
MOTORS
Brook Motor Corp 290
Reliance Electric & Engrg. Co. *
NUMERICAL CONTROL SYSTEMS
Bendix Corp 40-41
NUTRUNNERS
Chicago Pneumatic 264-265
OPTICAL COMPARATORS
Jones & Lamson Mch. Co 209
OPTICAL TOOLING SYSTEMS
Engis Equipment Co 304
Orban, Kurt Co., Inc 219
PLANERS
American Waldrich Mfg. Corp. *
Gray, G. A. Co
Lapointe Mch. Co * Rockford Mch. Tool Co 76-77
100 CO 10-77

PRESS BRAKES
Cincinnati Shaper Co 18-19 Verson Allsteel Press Co 74
MATERIA
Allen, Alva *
Beatty Mch. & Mfg. Co *
Birdsboro Corp
Chambarshung France Co *
Chambersburg Engrg. Co * Cleveland Punch & Shear 319
Danly Mch. Specialties, Inc 259
Denison Engrg. div 277
Elmes/King div. American
Steel Foundries *
Erie Foundry Co
Hannifin Corp
Hydraulic Press Mfg. Co. 241 L & J Press Corp. * Lempco Industrial, Inc. * Minster Machine Co. *
Lempco Industrial, Inc *
Minster Machine Co *
Niagara Mch. & Tool Works 247
Steelweld div., Cleveland Crane 66
Verson Allsteel Press Co *
Wilson, K. R
TO SECURE SECURITION AND ADDRESS OF THE PARTY OF THE PART
PRESS FEEDING EQUIPMENT
PRESS FEEDING EQUIPMENT U. S. Tool Co., Inc 10-11 PROGRAMMING EQUIPMENT Prider (Florospites)
PROGRAMMING EQUIPMENT
Friden (Flexowriter) 68
PUMPS
Brown & Sharpe Mfg. Co * Ruthman Machinery Co 296
Vickers, Inc 283
PUNCHING & NIBBLING MACHINES
Buffalo Forge Co56-57
Wales Strippit, Inc 310
SAWS
Armstrong-Blum Mfg. Co *
Armstrong-Blum Mfg. Co * Capewell Mfg. Co *
Circular Tool Co., Inc *
SCALES
Fairbanks, Morse *
SCREWDRIVERS
Chicago Pneumatic 264-265
SCREWS, ACTUATOR
Jerphak Bayless *
SHAPERS
Lapointe Mch. Co *
SHEARS
Buffalo Forge Co. (Billet) 56-57
Cincinnati Shaper Co
Cleveland Crane & Engrg *
SHIMS
Laminated Shim Co., Inc 116
SLITTING EQUIPMENT, ROLL & SHEET
Yoder Co
SPEED REDUCERS
Boston Gear Works 291
Reeves Pulley Co. div. Reliance
Electric 267
SPINDLES
-
Pope Mchry. Corp *



Specialization is part of the answer for Slocomb makes only micrometers and no other type of measuring gage, tool or instrument. This concentration on producing the widest possible variety of fine, precision micrometers has resulted in a line of over 900 different models!

Whatever your micrometer needs, chances are Slocomb can supply it . . . fast. From 1° conventional micrometer calipers to 60° Rigitube models . . . airfoil, tube, screw thread, sheet metal types . , . just to mention a few.



# SPEEDMIKE

Another Slocomb first1 Digitally read, the new Speedmike achieves the witimate in measuring speed and accuracy. Yes . . . you can have "direct reading" on other Slocomb micrometers.





By Your Industrial Distributor

J. T. Slocomb Co.

101 Matson Hill Rd., So. Glastonbury, Connecticut Circle this page number on card

# free literature guide

Want more information? Below are listed the products described in this issue. Page number after company name refers to location of ad and number to be circled on cards for literature.

SPRAYING EQUIPMENT, FLAME  Metallizing Engineering Co., Inc	American Tool Works Co	Greenlee Bros. & Co
Crucible Steel Co	TOOL HOLDERS Armstrong Bros. Tool Co	WAY COVERS         274           Futurmill, Inc.         274           WELDING EQUIPMENT         Federal Machine & Welder Co.         294           Hamilton Electrona, Inc.         229           Lincoln Electric Co.         54-55           Linde Co.         260-261
Thomson Industries	TRANSFER MACHINES, MULTI-UNIT         Barnes, W. F. & John Co 80-81         Buhr Mch. Tool Co 244-245         Cincinnati Milling Mch. Co 6-7         Cross Co 16-17         Davis & Thompson 316	WELDMENTS Kirk & Blum Mfg. Co. *  ZINC New Jersey Zinc Co. *  * Advertisement appeared in previous issue.

Now! Finish parts up to 100 times faster at greatly reduced cost! The secret-



... the latest method for cleaning, descaling, deburring, grindling, radiusing, fine-finishing, coloring and burnishing all metal and metal alloy parts, many suitable plastic and ceramic items ... with the Pangborn Air-Cushioned Vibratory Finishing Machine!

The Pangborn Air-Cushioned Vibratory Finishing Machine gives you wider range of application, larger payloads and greatly-reduced time cycles resulting in tremendous savings. It easily handles parts too delicate and intricate to finish by other methods . . . works on shielded areas and interior surfaces . . . does coarser jobs faster with impressive cost reductions. Available in  $1\frac{1}{2}$ , 3, 6, 12 and 18 cu. ft. net capacity sizes. For details or to arrange demonstrations on your own parts, write Vibratory Finishing Division, Pangborn Corporation, 1200 Pangborn Blvd., Hagerstown, Maryland.

336

- Works up to 100 times faster than conventional methods; does more work better at lower cost
- Does work impossible to do by barrel finishing or other means
- · Most compact vibrator on the market
- Air cushion support and suspension for automatic leveling and amplitude control supplants spring suspension systems subject to fatigue
- Standard basic machines are equipped with mechanically variable speeds
- Floor vibration entirely eliminated, making possible (for the first time) second floor mounting



Find sources for more data, quickly, easily. Use MACHIN-ERY'S free literature guide on preceding pages. Advertisers in this issue are listed alphabetically by product. Page numbers following company names indicate both location of ad and number to be circled on cards for more data.

# feel free to use cards below ... to obtain free literature on products advertised or described in this issue

- Circle page numbers of advertisements—if no page number appears on ad refer to advertisers' index or free literature guide.
- 2. Circle item numbers of new equipment, catalog descriptions.
- 3. Mail . . . we'll do the rest.

	12 2	2 2	90	2 2	72	2	8	108	071	77	357	270	282	ž	306	328	334	A-2	ACK		512	224	2 2	98		281	283	2 5	3 6	9	53	9/9						
	= 1	3 %	3 5	200	3 5	: 22	g	101	9	216 216	35.6	269	281	293	382	325A	333	A-1	B	bers	511	523	25	559		280	285	100	910	3	652							
	2 2																		BACK	Numbers	510	225	334 846	258		579	291	615	CTO	629	651							
																-	330	,	_	Item	209	521	533	257	569	218	236	700	\$10 \$10	9 6	99					:		:
																	327D 3	119	INSIDE	Circle	208	520	532	556	268	577	286	100	613		619							
																	327C 3		I I	Ĭ	201	619	123	18	191	91.6	886	000	719	100	148							
																		[m	NSIDE FRONT	atalogue	)			199														:
CHILL																	IA 327B	17	SIDE	0															:	:		
NOT ITS																- 44	ATZE	-	N I	quipment	170			2														:
20																-	E 326		FRONT	-				225														
																	325E			r New											13	Int				:		RESS
																	3250	336	COVERS	2	502	514	226	28 28	562	571	283	232	607	619	23	Please print				COMPANY		ADDRESS
	1	12	23	3	9 :	73	2	97	109	201	219	243	271	283	295	307	1150	335	8		201	513	525	249	561	570	582	294	909	618	23	Piec	-		THE STATE OF	000		0
_					-	-	-	-				-	-	-			-		-			-	-				_	-	-	-	-		-		 -	 	-	
																				_						_	00	-										
	12	24	25	48	3	2 3	8 8	1 3	120	217	241	257	212	207	306	318	3258	A-2	<b>NCK</b>		512	524	536	2 2	5	58	20	3	119		3	9/9						
																	-4	A-1 A-2	- BACK		M			560 560								9/9						
SU SU	11	23	14	47	2	E 8	2 2	167	119	216	23	957	692	292	302	317	75A	A-1	- B	Mirmhare	M	22	235		8	280	592	3	919	8		9/9						
NUMBERS	10 11	22 23	34 35	46 47	28	5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	20 20	106 107	118	215 216	237 239	255 256	268 269	202 202	304 305	316 317	124 325A	A-1	BACK - B.	Ham Mirmhare	510 511	525 523	534 535	546 547	999	579 580	591 592	603 604	615 616		25	•						
rage Numbers	9 10 11	22 23	23 34 25	15 46 47	57 58 59	02 05 EE	28 28 18	165 106 167	117 118 119	213 215 216	235 237 239	253 255 256	267 268 269	202 202 106	303 304 305	315 316 317	121B 324 325A	720 A-1	BACK - B.	Circle Hem Mirmhers	509 510 511	521 522 523	533 534 535	545 546 547	569	578 579 580	590 591 592	602 603 604	614 615 616	829 129 929	650 651 652	•						
Irde Page Numbers	8 9 10 11	20 21 22 23	22 23 34 35	44 45 46 47	56 57 58 59	17 07 09 29 17 07 09 19	28 18 28	164 165 106 167	116 117 118 119	211 213 215 216	22 235 237 239	252 253 255 256	206 267 268 269	202 202 102 002	302 303 304 305	314 315 316 317	323A 323B 324 325A	719 720 A-1	- INSIDE BACK - B	Circle Ham Mirm	Sag 509 510 511	520 521 522 523	532 533 534 535	544 545 546 547	568 569	577 578 579 580	589 590 591 592	601 602 603 604	613 614 615 616	625 626 621 628	649 650 651 652	•						
ts—Circle Page Numbers	7 8 9 10 11	19 20 21 22 23	11 12 13 34 35	43 44 45 46 47	55 56 57 58 59	11 68 69 70	19 80 81 82 83	20 10 20 20 10 101	115 116 117 118 119	200 211 213 215 216	211 222 235 237 239	251 252 253 255 256	265 266 267 268 269	200 200 201 202 203	301 302 303 304 305	313 314 315 316 317	322 323 3236 324 325A	718 719 720 A-1	- INSIDE BACK - B	Circle Ham Mirm	Sag 509 510 511	519 520 521 522 523	531 532 533 534 535	543 544 545 546 547	567 568 569	576 577 578 579 580	588 589 590 591 592	600 601 602 603 604	612 613 614 615 616		648 649 650 651 652	•						
ements—Circle Page Numbers	6 7 8 9 10 11	18 19 20 21 22 23	20 21 22 23 34 25	42 43 44 45 46 47	54 55 56 57 58 59	11 02 69 69 29	78 79 80 81 82 89	167 167 164 165 106 107	114 115 116 117 118 119	207 209 211 213 215 216	229 221 222 225 227 239	250 251 252 253 256 256	264 265 206 267 268 269	210 211 210 213 200 204	300 301 302 303 304 305	312 313 314 315 316 317	321D 322 323A 323B 324 325A	717 718 719 720 A-1	DE FRONT - INSIDE BACK - B.	Cataloniae Circle Ham Mirri	506 509 510 511	518 519 520 521 522 523	530 531 532 533 534 535	542 543 544 545 546 547	566 567 568 569	575 576 577 578 579 580	587 588 589 590 591 592	599 600 601 602 603 604	611 612 613 614 615 616	C23 C24 C25 C26 C21 C28	647 648 649 650 651 652	9						
vertisements—Circle Page Numbers	5 6 7 8 9 10 11	17 18 19 20 21 22 23	25 36 31 32 33 34 35	41 42 43 44 45 46 47	53 54 55 56 57 58 59	55 66 69 70 TO	28 18 88 61 82 11	101 101 101 101 101 101 101	113 114 115 116 117 118 119	205 207 209 211 213 215 216	227 229 231 222 235 237 239	249 250 251 252 253 255 256	263 264 265 266 267 268 269	202 007 017 017 117 017 C17 202 006 006 006 006 006	299 300 301 302 303 304 305	311 312 313 314 315 316 317	1 321C 321D 322 323A 323B 324 325A	716 TIT 718 TI9 720 A-1	- INSIDE FRONT - INSIDE BACK - B	name Cataloniae Circle Ham Mimi	205 506 507 508 509 510 511	517 518 519 520 521 522 523	529 530 531 532 533 534 535	541 542 543 544 545 546 547	565 566 567 568 569	574 575 576 577 578 579 580	586 587 588 589 590 591 592	598 599 600 601 602 603 604	610 611 612 613 614 615 616		646 647 648 649 650 651 652	•						
or Advertisements—Circle Page Numbers	4 5 6 7 8 9 10 11	16 17 18 19 20 21 22 23	28 29 39 31 12 33 34 35	40 41 42 43 44 45 46 47	52 53 54 55 56 57 58 59	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	76 77 78 79 80 81 82 83	58 86 52 54 16 06 68 88	112 113 114 115 116 117 118 119	294 205 207 209 211 213 215 216	225 227 229 221 222 225 227 229	247 249 250 251 252 253 255 256	262 263 264 265 266 261 265 262	202 007 017 017 117 017 C17 116 116 116 116 116 116 116 116 116 1	298 299 300 301 302 303 304 305	310 311 312 313 314 315 316 317	321B 321C 321D 322 323A 323B 324 325A	715 716 717 718 719 720 A-1	- INSIDE FRONT - INSIDE BACK - B	Familianes Cotalonies Circle Item Mirro	KAA KAK KAK KAC KAT KAA 500 STO STI	516 517 518 519 520 521 522 523	528 529 530 531 532 533 534 535	540 541 542 543 544 545 546 547	561 568 567 568 569	573 574 575 576 577 578 579 580	585 586 587 588 589 590 591 592	597 598 599 600 601 602 603 604	000 610 611 612 613 614 615 616		645 646 647 648 649 650 651 652	•						
For Advertisements—Circle Page Numbers	3 4 5 6 7 8 9 10 11	15 16 17 18 19 20 21 22 23	27 28 29 39 31 12 13 34 35	39 40 41 42 43 44 45 46 47	51 52 53 54 55 56 57 58 59	CS 64 65 06 67 68 69 70 71	25 15 00 17 17 17 17 17 17 17 17 17 17 17 17 17	57 585 589 300 91, 325 353 394 585 104 107 and 107	111 112 113 114 115 116 117 118 119	203 204 205 207 209 211 213 215 216	223 225 227 229 231 222 235 237 239	245 247 249 250 251 252 253 255 256	261 262 263 264 265 266 261 268 269	202 207 217 217 117 017 C17 316 206 206 206 206	297 298 299 300 301 302 303 304 305	309 310 311 312 313 314 315 316 317	321A 321B 321C 321D 322 323A 323B 324 325A	715 716 717 718 719 720 A-1	FRONT - INSIDE FRONT - INSIDE BACK - B	name Cataloniae Circle Ham Mimi	KAN KAI ZAK KAK KAT KAR 500 510 511	515 516 517 518 519 520 521 522 523	527 528 529 530 531 532 533 534 535	539 540 541 542 543 544 545 546 547	561 564 565 566 567 568 569	572 573 574 575 576 577 578 579 580	584 585 586 587 588 589 590 591 592	596 597 598 599 600 601 602 603 604	008 009 610 611 612 613 614 615 616	620 621 622 623 624 625 626 621 628	644 645 646 647 648 649 650 651 652	9						
For Advertisements—Circle Page Numbers	2 3 4 5 6 7 8 9 10 11	14 15 16 17 18 19 20 21 22 23	26 27 28 29 39 31 12 13 34 35	38 39 40 41 42 43 44 45 46 47	50 51 52 53 54 55 56 57 58 59	C2 C3 64 65 06 67 68 69 70 71	74 75 76 77 78 79 80 81 82 82	26 57 56 59 30 30 31 32 32 35 56 56 56 56 56 56 56 56 56 56 56 56 56	110 111 112 113 114 115 116 117 118 119	202 203 204 205 207 209 211 213 215 216	220 223 225 227 229 231 222 235 237 239	244 245 247 249 250 251 252 253 255 256	260 261 262 263 264 265 206 201 268 200	107 007 617 617 117 017 617 517 517 217 217 217	296 297 298 299 300 301 302 303 304 305	308 309 310 311 312 313 314 315 316 317	320A 321A 321B 321C 321D 322 323A 323B 324 325A	715 716 717 718 719 720 A-1	VERS: FRONT - INSIDE FRONT - INSIDE BACK - B	Familianes Cotalonies Circle Item Mirro	KAN KAI ZAK KAK KAT KAR 500 510 511	515 516 517 518 519 520 521 522 523	527 528 529 530 531 532 533 534 535	539 540 541 542 543 544 545 546 547	561 564 565 566 567 568 569	572 573 574 575 576 577 578 579 580	584 585 586 587 588 589 590 591 592	596 597 598 599 600 601 602 603 604	008 009 610 611 612 613 614 615 616	620 621 622 623 624 625 626 621 628	645 646 647 648 649 650 651 652	9		NAME	HTE	COMPANY		CO. ADDRESS



# information center

Reverse side of this card gives instructions on how to use postcards below to obtain new catalogs, data on new equipment described, and products advertised in this issue. In the Free Literature Guide immediately preceding these cards advertisers are listed by product group to facilitate location of advertisements on which you desire additional data and catalogs.

This card expires Sept. 1, 1960

FIRST CLASS Permit No. 53 New York, N. Y.

# BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

# 93 WORTH STREET NEW YORK 13, N.Y.

READERS' SERVICE DEPT.

This card expires Sept. 1, 1960

FIRST CLASS Permit No. 53 New York, N. Y.

# BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

**MACHINERY** 

93 WORTH STREET

NEW YORK 13, N.Y.

READERS' SERVICE DEPT.



# BOOKS LIKE THESE ARE RELIABLE TOOLS THAT CAN HELP YOU IN YOUR WORK!

# MACHINERY'S HANDBOOK— 16th Edition

A modern handbook is a necessity for every man who holds or hopes to hold a responsible job in the mechanical industries. This one is the "Bible" of them all. The latest edition of this world-renowned book combines all the valuable features of earlier editions with the most recent and useful machine-designing and machine-shop data obtainable. 192 pages added to 15th Edition. Over 500 completely new pages of reference data. 2104 Pages, Thumb Indexed.

# THE USE OF HANDBOOK TABLES AND FORMULAS

A companion book for users of MA-CHINERY'S HANDBOOK which shows you how to get the most out of your Handbook. Examples, solutions and test questions show typical applications of Handbook matter in both drafting-rooms and machine shops.

\$2.00 Special combination price with MACHINERY'S HAND BOOK, \$12.50

### DIE-CASTING-2nd Edition

by Charles O, Herb Illustrates and describes the latest diecasting machines. Tables of die-casting alloy compositions, the latest developments, discussion of their properties and applications. 196 Illustrations. 310 Pages. \$5.00

#### **MATHEMATICS AT WORK**

by Holbrook L. Horton

100 pages of reviews of the fundamentals of arithmetic, algebra, geometry, trigonometry and logarithms. 482 pages of illustrated mechanical problems with step-by-step analyses and solutions. 146 pages of standard mathematical tables needed for all types of problem solving. 196 Illustrations.

\$7.50

## MACHINE TOOLS AT WORK

2nd Edition—by Chorles O. Herb Applications of standard and special machine tools, with data on speed, feed, production, etc. Covers turning, thread milling, thread grinding, drilling, tapping, boring, punching, riveting, planing, shaping, broaching, honing, superfinishing and much more. 584 pages, 434 illustrations.

#### **GEAR DESIGN SIMPLIFIED**

by Franklin D. Jones
In chart form. Contains 110 gear-problem charts and worked-out examples of
gear design that show exactly how rules
are applied in obtaining essential dimensions, angles, or other values. 201
Drawings. 134 Pages.
\$4.50

More Books Described On Reverse Side

# Order Them by Mail

# JUST PUBLISHED!

# THE NEW PRODUCT

by Delmar W. Karger

A book that explains and relates all the complex aspects of product development.

Intended for management with little or no experience on successful product development, THE NEW PRODUCT is a guide they can turn to for help in every area of product development, from where to get ideas to how to advertise.

It describes in detail how to find ideas, how to test, develop and sell new products. Useful checklists are provided to aid a manager in avoiding common pitfalls and at the same time help him secure the step-by-step success of his project.

Basic concepts of top management planning and organization for new product development are covered, as well as each major functional area of the business enterprise regarding the successful development and marketing of new products.

Today the manufacturer is in the challenging position of having to recognize and utilize his resources to the fullest—to seek new products for new business. NEW PRODUCTS provides the answers for the manufacturer who wants to know how to develop new, successful products; new profitable markets. 21 Charts & Illustrations. 234 Pages.

\$5.00

# DIE DESIGN AND DIEMAKING PRACTICE

3rd Edition-by Franklin D. Jones

Drawings and descriptions of a tremendous variety of dies and a vast amount of data to help you avoid expensive mistakes and delays. A standard reference work in the metal-working industries, used by some 40,000 diemakers, designers and tool engineers. 661 Illustrations, 1083 Pages.

\$10.00

# DIMENSIONS AND TOLERANCES FOR MASS PRODUCTION

by Earle Buckingham

An analysis of the many problems of dimensioning with tolerances for mass production, showing their effect on tool design, gage design, production and inspection, and suggesting improved methods and practices to solve these problems. 179 Illustrations. 164 Pages.

\$8.00

# MACHINE TOOLS—What They Are and How They Work

by Herbert D. Hall and Horace E. Linsley

Introduction to fundamentals of mass production. Covers each machine tool, how and where it functions, skills and organization that make modern mass production possible. A basic, thorough text on all phases of metalworking operations. 363 Illustrations. 488 Pages. \$5.50

#### APPLIED ELECTRICITY—4th Edition

by H. Cetton

Elementary text for first course in colleges and technical schools. Ideal for home study. Covers basic principles; contains diagrams, examples and problems. 387 Illustrations. 476 pages.

\$5.00

Use this handy order card to order your books.

Mail it today postage-free.

FIRST CLASS
Permit No. 53
New York, N. Y.

# BUSINESS REPLY MAIL

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY

THE INDUSTRIAL PRESS
93 WORTH STREET

NEW YORK 13, N. Y.

BOOK DEPT.



# PUT THE FACTS AND FIGURES YOU NEED AT YOUR FINGERTIPS - WITH BOOKS!

#### ENGINEERING ENCYCLOPEDIA

by Franklin D. Jones

Condensed and practical information on 4500 subjects definitions of numerous terms used in engineering and manuterms used in engineering and manufacturing practice, the results of many costly and important tests and experiments. No single work will give you a broader knowledge with less reading effort. 206 Drawings. 1431 Pages.

NOW in ONE Volume, \$10.00

# MACHINERY'S MATHEMATICAL

Edited by Holbrook L. Horton

This book has been serving mechanical engineers, machine designers, draftsmen, toolmakers, machinists and students for over 30 years! Now it is available in a greatly enlarged version, containing the authoritative, easy-to-use mathematical tabular information you need on the job. Designed for speed and utility. 254 pages.

\$3.75

#### PIPE AND TUBE BENDING

by Paul B. Schubert

Defines the six basic ways by which the bending of ferrous and non-ferrous pipe and tube may be accomplished. Descriptions of methods, applications, and features of the equipment available. 159 Illustrations. 183 Pages.

### JIG AND FIXTURE DESIGN

by Franklin D. Jones

A thorough coverage of the principles of development and constructional details of jigs and fixtures. Designs show principles of construction that can be applied successfully to a variety of jig and fixture design problems. 345 Illustrations. 406 Pages.

HOME ADDRESS .....

\$5.00

# Order Them by Mail

### QUALITY CONTROL

New 4th Edition—by Norbert L. Enrick Principles and techniques for everyday use. Shows manufacturers how to improve average quality of products and save money. Explains use of statistics for establishing tolerances which are applied to dimensions of components and assemblies as well as tolerances for non-dimensional quantities. Shows stepby-step improvement in long-run production operations. 216 pages.

### INSPECTION AND GAGING-2nd Ed.

by Clifford W. Kennedy
The specific functions of manual and automatic measuring devices and gages, the techniques of using them. Analyzes the methods and duties of the different types of inspectors. Ideal for use in the plant or as training course text. 345 Illustrations. 522 Pages.

\$9.00

## HYDRAULIC AND PNEUMATIC POWER FOR PRODUCTION

by Harry L. Stewart Contains information on fluid-power contains information on fluid-power circuits, types of equipment and operational details useful to designers, buyers, installers and operators of hydraulic and pneumatic equipment. Describes step-by-step how air and oil equipment can be applied to the manual and automatic operations of all types of production machinery. 348 Illustrations. 416 \$8.50

#### SELLING TO INDUSTRY

by Bernard Lester
64 articles on how you can do a better
sales engineering job. Covers the problems encountered in selling industrial
products or services and discusses successful selling techniques. Case historics, 255 pages. \$4.00

Use the postpaid card below to order the books you want. We will bill you later. Remember, you save postage charges on the books when you send payment in full with your order.

# THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N. Y. Please send me the following books. ■ Bill me. ■ Bill company ■ Payment enclosed, send beeks postpoid. Orders from fereign countries, except Canada, must be accompanied by payment in full including 504 per beek, postage and handling. COMPANY ..... COMPANY ADDRESS .....

..... ZONE ..... STATE ......

CITY ..... ZONE ..... STATE ......

(please fill in home address only if you want books sent there)

M/6/60

#### BETTER TOOL CRIBS

by William Raisglid

How to organize and operate an efficient tool crib with maximum benefits. How to avoid wasteful, haphazard methods of tool crib operation. Complete control systems based on the use of brass tool checks and triplicate tool charge slips are clearly described. 87 Illustrations. 152 Pages. How to organize and operate an efficient

\$4.00

#### MACHINE SHOP TRAINING COURSE

by Franklin D. Jones

Contains 1124 pages of questions and answers, shop problems and solutions, blueprint reading charts. Illustrated by 572 drawings and photographs. For use as a textbook or for designers and production engineers who want the fundamentals of machine shop practice.

Two-Volume Sat. \$9.00

Single Volume, \$5.50

## INDUSTRIAL LUBRICATION PRACTICE

by Paul D. Hobson

Practical working manual covering motors, engines, turbines, compressors, refrigeration equipment, machine tools, pneumatic and hydraulic tools, and other industrial and marine equipment. Chapters on oil purification and reclamation, use of cutting fluids, and storage preservation of machinery. 167 Illustrations, 534 Pages.

\$8.00

## GEAR RATIOS FOR 4- 6- AND 8-**GEAR COMBINATIONS**

by Earle Buckinghan

Simple method for determining sets of 4-, 6- and 8-change gears to meet pre-cision gear ratio requirements. Features tables of pairs of consecutive factorable numbers from 1000 to 40,000, their ratios and reciprocal ratios to use in making 4, 6- and 8-gear combinations. 95 Pages.

\$

\$5.00

## DRAFTSMAN'S MATHEMATICAL MANUAL

by Franklin D. Jones

Draftsmen supplied, out of their daily experiences, this useful collection of classified problems and solutions. Contains principles of algebra, equations, problems involving unknown angles, solution of triangles to determine linear dispensions adjusting transport dispensions adjusting transport dispensions and problems. dimensions, calculating unknown diameters or radial dimensions, and general engineering and designing problems. \$3.50

> More Books Described On Reverse Side



Benefit? Turbo-Cut's longer chamfer distributes the load over more teeth and breaks up chips to minimize tap breakage. Turbo-Cut's longer chamfer makes tapping easier and cleaner on through holes, does a one-pass job on blind holes. Only Threadwell makes the genuine Turbo-Cut with the longer chamfer.

Also available in bottoming chamfer.

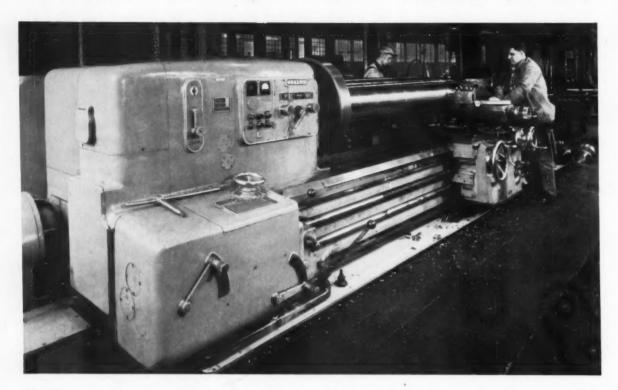
Threadwell

THREADWELL TAP & DIE CO. GREENFIELD, MASSACHUSETTS

Stocking Warehouses: New York — Cleveland Detroit — Las Angeles — Greenfield, Mass.



# "Dyna-Shift" lathe ups output 25%, tool life 50%, —30 Timken bearings maintain rigidity, accuracy



YOU merely set the controls of the Dyna-Shift drive on this Monarch Series 90 lathe to get the correct speed automatically. What's more, the "90" can be kept under full load at any speed, using modern tooling. Results, reports Monarch, show up to 25% more output and 50% greater tool life than with other equipment. Thirty Timken® tapered roller bearings at vital points—

spindle, gear box, apron and tailstock—assure constant rigidity and accuracy, for maximum economy.

Most American machine tool builders use Timken bearings. Two big reasons are: 1) The taper lets Timken bearings take *both* radial and thrust loads or any combination. 2) Precision manufacture of Timken bearings assures high precision in the machine.



EXTRA ENGINEERING SERVICE. Often, our graduate engineer salesmen can solve your bearing problems on the spot, at the design stage, save you time and money.



THE FINEST GAGE LAB in the industry assures you top bearing accuracy. Some instruments we use measure even the thickness of a molecule, split a hair 30,000 times.



TIMKEN

tapered roller bearings

The Timken Roller Bearing Company, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

